ARCHIVES

OF

MEDICINE:

VOL. II.

ARCHIVES

OF

MEDICINE:

A RECORD OF PRACTICAL OBSERVATIONS AND ANATOMICAL AND CHEMICAL
RESEARCHES CONNECTED WITH THE INVESTIGATION AND
TREATMENT OF DISEASE.

EDITED BY

LIONEL S. BEALE, M.B., F.R.S.

VOL. II.

With Cases and Original Papers

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LONDON:

PREFACE TO VOL. II.

Four years have now elapsed since the appearance of the first
number of the "Archives of Medicine." The Editor desires
to offer to all Contributors his most cordial thanks. He
particularly desires to acknowledge the important assistance
he has lately received from his friend Dr. Duffin.

Although the Editor has been unable to issue a number of
the Journal regularly on October 1st, and March 31st, two
numbers have appeared in each year as was promised. It is
hoped that in future a number will appear on the 1st of
October, January, April, and July.

This volume contains four coloured plates, part of the
expense of which has been most liberally borne by the authors
of the papers which they illustrate. It is hoped that the care
with which the plates have been executed, will in some measure
compensate for the smaller number in the present volume.

The principle of free illustration, and the substitution of
drawings for description whenever possible, which distinguishes
this Journal, will still be adhered to, and it is hoped that an
increased number of subscribers will enable the Editor to con-
duct the Journal on a still more liberal scale without serious
loss.

It should be known that the receipts will be entirely devoted
to the Journal, and it will be progressively enlarged as its
circulation increases. The only expenses besides printing,
paper, and illustrations, are the publisher's commission, and
advertising.

It is calculated that every twenty subscribers over 500 would permit an increase of one plate and one sheet of letter-press in the year. A circulation of 500 will enable the Editor to issue four numbers nearly as large as those in this volume, in the year, at the price of half-a-crown, instead of three shillings and sixpence.

The value of a work which contains memoirs on various subjects is much enhanced by being furnished with a good index, and it is believed that an index which grows as the work progresses would greatly add to its usefulness, and much facilitate reference to all that it contains.

The index of the first volume of the "Archives" has been re-arranged with that of the present one, and it is proposed to carry out this plan with the three next volumes, so that each volume will contain references to those which have preceded it.

Every year the number of writers on scientific subjects in connection with Medicine greatly increases, and it is very important that contributors should arrange their matter very carefully. There can be no doubt that very many valuable researches are passed over solely in consequence of the matter being badly arranged and the paper not being provided with a summary. If our Continental neighbours were acquainted with the difficulties we encounter when we attempt to master their long papers, they would certainly make a rule of appending summaries of the results.

Contributors to the "Archives" are permitted to have twelve reprints of their papers free of expense, and as many extra copies as they desire at small cost. Electrotypes of the wood engravings may also be had on certain conditions.

61, Grosvenor Street, London, W.,
        May, 1861.

ARCHIVES

OF

MEDICINE.

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TABLE OF CONTENTS. (Vol. II).

PAGE

I. CLINICAL OBSERVATIONS—

II. ORIGINAL RESEARCHES IN ANATOMY AND PHYSIOLOGY, AND MORBID ANATOMY AND PATHOLOGY—

III. RESULTS OF THE CHEMICAL AND MICROSCOPICAL EXAMINATION OF SOLID ORGANS AND SECRETIONS.

PLATES AND WOOD-CUTS.

ARCHIVES

OF

MEDICINE.

CLINICAL OBSERVATIONS.

CASE OF LEUCOCYTHEMIA.

By J. Milner Barry, M.D., M.R.C.P.,

Physician to the Tunbridge Wells Infirmary and Dispensary.

THE following case illustrates many of the clinical points usually observed in cases of this affection. The spleen was of very large size, and the white corpuscles in the blood very numerous.

History.—William Knight, aged 39, was admitted into the Tunbridge Wells Infirmary, January 11, 1859. He has for many years worked laboriously as a brickmaker and potter, but enjoyed, through life, excellent health, until three months ago, when he began to feel weak and unable to work, and he then noticed that his belly was getting very large and hard. Has had prolapsus ani and right inguinal hernia for several years. Had not lived in marshy districts, and never had ague.

Fig. 1.

Diagram showing the extent of splenic dulness.

Present state.—Stature rather short, hair dark, aspect bilious but not cachectic, conjunctiva vascular but not jaundiced. He complains of anorexia, indigestion, diarrhœa, abdominal distension, and disturbed unrefreshing sleep; can lie in any position, and with the head low. The abdomen is prominent, hard, and tense, measuring over thirty-six inches in girth, a hand breadth above the navel, and thirty-five inches round the navel. The liver is enlarged and somewhat protuberant, and descends to three inches below the margin of the ribs. The left side of the abdomen sounds

dull to percussion from the ribs nearly down to Poupart's ligament, and is occupied by a hard smooth tumour, evidently the hypertrophied spleen, not tender to touch, and bearing any amount of manipulation without being painful.   After emerging from the ribs it descends perpendicularly about an inch to the left of the median line, until it reaches the level of the navel, where it sweeps away to the left for a short distance, and then curves forward and terminates in a rounded prominence about an inch above the symphisis pubis.   The anterior margin is smooth, rounded off, with a notch about half way down.   The abdomen, where not occupied by the liver and spleen, has a clear tympanitic sound.   No fluctuation.   No œdema.   No appearance of distended blood-vessels over the surface of the abdomen. Pulse 80, weak, regular.   Tongue clean.   About three pints of urine passed in the twenty-four hours, usually turbid from the presence of urates, not albuminous, sp. gr. 1015—1018.

FIG. 2.
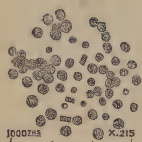
Appearances of a drop of blood, X 215.
Showing white corpuscles.

Under the microscope a drop of blood from the finger exhibits a large number of white corpuscles, larger than blood disks, resembling pus-globules.

I ordered him nourishing diet, iodide of iron, sulphate of iron, with the extracts of aloes and henbane in pills, and the ung: iodinii co, to be rubbed over the left side of the abdomen.

February 26.—General health much improved, appetite and digestion good, sleeps well and feels stronger.   The abdominal enlargement is greater than it was upon admission.   He now measures thirty-seven inches in girth at four inches above the navel, and thirty-six inches round the navel.

Ordered to discontinue the iodide of iron and the iodine ointment, to continue the pills, to have the following mixture and to rub in a portion of the ointment over the left side of the abdomen:—

℞ Potassii bromidi Əj
Extracti sarzæ fluidi ℥ss
Aquæ puræ ℥vss
M. ft. mistura cujus capiat quartam partem bis in die.

℞ Potassii bromidi ℥ij
Adipis ℥ij
M. ft. unguentum nocte manèque infricendum.

March 28.—Health improved, feels stronger, walks out for some hours every day.   The tumour feels softer, and his girth is somewhat less, but the white corpuscles seem to be more numerous.

July 4.—With occasional intervals of a few days, the bromide of potassium mixture and ointment were continued since the 26th February, and, seemingly, with advantage.   The patient was always anxious to resume the medicine, and to rub in the ointment, as he did not feel so well when they were pretermitted. The tumefied spleen appears to be diminished in bulk, as determined by palpation and measurement, the liver remains unaltered.   The patient looks ill, and has for two or three weeks been complaining of aching pains in the lumbar and sacral regions, but he is still able to walk about and take exercise very well. There is no appearance of jaundice or of dropsical effusion.

The blood was examined from time to time under the microscope, and at every successive examination the proportion of colourless corpuscles appeared to be augmented.

TABLE OF MEASUREMENT OF ABDOMEN.

	GIRTH IN INCHES.					
	Jan. 11	Feb. 26	Mar. 28	April 23	May 17	July 4
Three inches below nipples	..	36	36	$35\frac{1}{2}$	$35\frac{1}{2}$	35
Four inches above navel	$36\frac{1}{2}$	$37\frac{1}{4}$	$36\frac{3}{4}$	36	$35\frac{1}{2}$	$35\frac{1}{4}$
Round the navel .	35	36	$35\frac{3}{4}$	$34\frac{3}{4}$	$33\frac{1}{2}$	$33\frac{1}{4}$

Knight was discharged from the Infirmary, July 4, 1859.

August 4th.—Knight after his return home continued for a fortnight or three weeks in much the same state as when he left the infirmary; then his strength seemed to fail rapidly, and ten days ago his face became puffed, then the legs and scrotum, and very soon general dropsy set in. I was requested to see him to-day, and found him sitting in a chair, from inability to lie down, and swollen and bloated from head to foot. The face and neck, scrotum and penis, upper and lower extremities, and the integuments of the abdomen are extensively infiltrated with serum, and there is fluid in the peritoneal cavity. Having much difficulty in micturating, in consequence of the distension of the scrotum and the curving of the penis, it became necessary more than once to make punctures in the integuments of these organs, through which much serum was drained away, to his great comfort. Diuretics and other means were employed with some temporary relief, but the dropsy went on increasing, he sank gradually, and died on the 9th of August.

Sectio cadaveris eighteen hours after death. General anasarca.

Thorax.—Lungs large, healthy, crepitating freely; a small quantity of sero-sanguinolent fluid in the pleural cavities; heart large, all the cavities dilated, nearly empty, some small friable dirty-yellow coagula in right ventricle; valves healthy, substance of the heart rather flabby.

Abdomen.—All the viscera dark from venous congestion. About a gallon of brownish serum in the cavity of the peritoneum. Liver of a deep red colour, congested, enlarged in all its dimensions, extending four or five inches below the hypochon-

drium; its capsule smooth; when cut into, sero-sanguineous fluid welled out abundantly from the incisions.

Gall-bladder.—Atrophied, about the size of the two first joints of the little finger, containing only a little mucus not tinged with bile. The cystic duct impervious, being obliterated at its issue from the gall-bladder by the pressure of two or three little cysts, the size of split peas, containing a dirty grey cheesy matter. Hepatic and common ducts unaltered. Pancreas large, loose in texture, otherwise healthy, and its duct free. *Spleen* attached at the upper part, and posteriorly and laterally, by old adhesions. Texture of the spleen firm, colour somewhat brownish, capsule healthy where free from the adhesions. I had no means of weighing the spleen; in shape it was somewhat oval, measured in circumference vertically twenty-eight inches, and sixteen inches around its greatest breadth. Loosely connected with it, and buried in the folds of the gastro-splenic omentum, was a small globular accessory spleen about the size of a walnut.

Kidneys.––Large, congested, dark, cortical portion rather coarse, medullary, healthy-looking. Intestines and stomach distended largely with flatus, dark, congested. The whole of the viscera thoracic and abdominal, appeared to be abnormally large.

Remarks.—This case is recorded as a contribution towards the history of Leucocythemia, the nature and pathology of which I do not propose to discuss at present. A brief remark or two in order to bring out some points of interest in reference to the case may be acceptable. When other therapeutical agents failed to procure any benefit or to produce any diminution in the abdominal enlargement; the bromide of potassium was exhibited, as a forlorn hope, (*melius anceps remedium quam nullum,*) upon the recommendation of the late Dr. Robert Williams, who believed it to possess* "unusual, if not specific, powers in the cure of diseases of the spleen." The size of the spleen seemed to diminish during its administration, and the patient felt better while taking it, and was always eager to resume it when it was occasionally discontinued. The bromide was perfectly tolerated, never occasioning any irritation of the stomach or bowels in this patient, and possibly by acting as a sorbefacient may have tended to ward off the dropsy. But in another case of splenic enlargement, in which several years ago I exhibited the bromide, it occasioned a good deal of irritation, and, I thought, did harm, so that I was obliged to forego its employment after a brief trial.

* Robert Williams, M.D., Elements of Medicine, vol. 1, 1836.

The complete occlusion of the cystic duct is an interesting feature of the case in connection with the fact that the patient had commonly, for many years, lax motions, and that his bowels were very readily disordered. It is a somewhat curious coincidence that, in a case of leucocythemia with hypertrophied spleen, which Dr. Murchison brought before the Pathological Society of London,* there was also collapse of the gall-bladder, its neck being completely obstructed, whilst the ductus communis was free and contained bile. And Andral records two cases in which the cystic duct was obliterated, the common duct pervious, and the spleen hypertrophied.† It is somewhat remarkable, that in the present case, in Dr. Murchison's and in one of Dr. Bennett's,‡ the presence of an accessory spleen is noted. This would seem to indicate that in leucocythemia there is a natural tendency to the formation of an exuberance of splenic tissue.

CASE OF DIABETES INSIPIDUS, WITH ANALYSIS OF THE URINE.

By Peter Eade, M.D., London,

Physician to the Norfolk and Norwich Hospital, &c., &c.

Case.—Henry M., æt 40, married, of average stature and proportions, but pale and puffy looking, admitted into the Norfolk and Norwich Hospital under my care on June 4th, 1859. He states that he always enjoyed good health until he went to London between four and five years ago. Whilst there he followed the occupation of a cab-horse keeper, and although accustomed to take two or three pints of porter daily, with on rare occasions a glass of gin, he was not intemperate, and by no means in the habit of getting intoxicated. After he had been in London a year, he was attacked with rheumatic fever (apparently subacute), for which he was treated in Saint Bartholomew's Hospital, and soon after recovery from this he began to suffer from thirst, loss of appetite, and headache, followed by an increase in the daily discharge of urine, the quantity varying much, but averaging from four to six pints in each twenty-four hours. These symptoms came on gradually, and have continued ever since, together with vague pains in the trunk and limbs, general feelings of debility, and constipation of the bowels alternating with diarrhœa.

Has suffered from bleeding piles for many years. Has spit blood in small quantities several times in the last three years, for the last two of which he has resided in Norwich.

On Admission.—Complains of general feebleness, and of aching pains referred

* Transactions of the Pathological Society of London, vol. vii, p. 238.
† Andral, Clinique Médicale. Tome 2. Third Ed. 1834. Obs. LI.—" Le canal cystique était transformé en un cordon fibreux jusqu'à son embouchure dans le canal hépatique. Le canal hépatique présentait son aspect normal. Le canal cholédoque s'ouvrait librement dans le duodénum. La rate était très volumineuse." Obs. LII.—" Le canal hépatique était sain, ainsi que le cholédoque. Un calcul, situé vers le milieu du canal cystique, en obliterait la cavité. Rate volumineuse et molle."
‡ Clinical Lectures, second edition, p. 822.

to the head, back, and various joints; of much thirst (to gratify which he is in the habit of drinking liquids freely); and of the discharge of an excessive quantity of urine, rising to pass it five or six times every night. He is languid and feeble, with a pale, pasty complexion, but is not emaciated. Pulse slow and weak. Heart's sounds, feeble and scarcely audible, apparently free from murmur. Respiration normal. Bowels at present rather constipated. Urine pale and watery looking— sp. gr. 1014, free from albumen, sugar, or excess of phosphates. There are no dropsical symptoms, and neither cough, expectoration, nor palpitation of the heart.

Ordered, full diet with a pint of porter daily, and to take

> Potassii iodid, gr. iij
> Tinct. ferri sesquichl. ʒss.
> Dec. Sarzæ co ʒj.   Ter in die.

June 14.—Reported to have suffered much from thirst, to have drunk much liquid, and to have passed nearly five pints of urine in the course of the preceding night, of sp. gr. 1003. It appears that the amount of liquids drunk bears a very close proportion to that of the urine passed, varying according to the degree of thirst experienced. Last night had again an attack of diarrhœa. Sleeps well and soundly in the intervals of rising to pass water.

> ℞   Tinct. Opii, ♏v.
>   Tinct. Catechu, ʒss.
>   Mist. Cretæ co. ʒj.   Ft. haust. p. r. n. sumend.

June 24.—Somewhat improved. Has gained a little flesh and strength. Still passes seven to eight pints of urine daily.

July 8.—There is again some looseness of the bowels, which appears to recur regularly at intervals of a few days and to reduce his strength materially.

> ℞   Acid Gallici, gr. v.
>   Acid Sulph. dil. ♏x.
>   Ferri Sulph. gr. iii.
>   Aquæ, ʒi.   Ft. haust. ter die sumend.

July 12.—Rather better. Daily quantity of urine is now from six to seven pints, the quantity of fluid drunk in the same time being ascertained to be four or five pints. Urine is now pale, clear, of a light yellow colour, acid, with a slight mucoid precipitate after repose, and not readily decomposing. Of sp. gr. 1005.

Some of this urine was now submitted to analysis for me by Mr. F. Sutton, an able chemist of this city, with the following results:—

Twelve imperial pints evaporated to dryness left of solid residue ·9285 per cent. (about 1000 grains).

Analysis 32.

Composition of Solid Residue.

				per cent.
Urea	..	..	..	60·000
Potash	..	..	..	5·630
Sulphuric acid	..	..	..	3·066
Phosphoric acid	..	..	..	2·966
Lime	..	..	..	·491
Chlorine ..	..	..	..	7·660
Soda and magnesia	..	..	..	11·140
Silica	..	..	..	·427
Ammoniacal salts, mucus, &c.			..	8·620

	100·000

Analysis 33.

Composition of the Urine, per 1000 grains.

Water	990·720
Urea	5·570
Uric acid .. .. a trace only.	
Potash	·522
Sulphuric acid	·284
Lime	·045
Phosphoric acid	·275
Soda and magnesia	1·033
Chlorine	·710
Silica	·041
Ammoniacal salts and mucus ..	·800
	———
	1000·000

August 7.—Left eye is severely inflamed (cause unknown) both superficial and deep vessels being engaged.

Hirundines iv. ad tempus applicand.

℞ Hydr. c. Creta, gr. ij.
Pulv. Ipecac. Co. gr. iiss.

In pil.; ter die sumend.

August 26.—Eye well. Feels better as to his general health, and has gained both flesh and strength.

℞ Tr. Ferri Sesq.: ℳxv.
Ex aq. ter die sumend.

September 16.—Pale, but on the whole improved. Urine is now sp. gr. 1018, pale, clear, in quantity about five and a half pints daily. Tested by the Volumetric method, it is found to contain 2·24 per cent. of urea.

October 26.—Again slightly improved as to his general health, but still pale, weak, and unable to do any work. Diarrhœa recurred last week. Thirst less, and daily quantity of urine not more than four pints. It is bright and clear, of sp. gr. 1018, and contains 20·10 per 1000 parts of urea, and ·15 per 1000 of uric acid.

November 9.—Reports himself as still continuing to mend. He has been able to do a little work. Amount of fluids drunk, three pints; of urine passed, four pints daily.

Remarks.—In my own practice I have now had four cases of this disease, two of the patients being children and the other two adults. The children were both unhealthy looking boys, who had suffered for a considerable portion of their lives from this disorder. One of them was remarkably benefited by the use of steel and quinine, and appeared indeed to be cured of his complaint, but after some months he relapsed. The other, after one or two visits, discontinued his attendance upon me, and I have lost sight of him. My adult patients were both men, of the respective ages of sixty-five and forty. The former,

a shoemaker residing in Norwich, without any known here-
ditary taint, but having suffered from jaundice, chronic rheu-
matism, and neuralgia, succumbed in eighteen months to the
exhausting effects of the disease, with its continued diuresis,
and the frequent urgent calls, both by night and day, to empty
the bladder. The amount of irritation of the bladder which
existed in this case was very remarkable and yielded to no
remedies. The quantity of urine varied from three to six pints
daily, never exceeded a specific gravity of 1008, and was free
from albumen, sugar, or other morbid ingredient. The micro-
scope showed nothing but epithelium and its débris, with some
mucus or pus globules. A *post mortem* examination showed
the following appearances :—

1. A bloodless state of the lungs; heart (cavities empty,
   and substance flabby) ; and large vessels; as well as
   of all the abdominal viscera.
2. Stomach empty, contracted, its mucous membrane of a
   claret-red colour, and covered with a mucous fluid
   like to thick gruel
3. The lobules of the pancreas appeared to be slightly
   enlarged, and more than usually distinct from each
   other, as if from the absorption of fat. A portion of
   its centre was much denser than the rest.
4. Spleen and liver healthy. Gall-bladder full.
5. Bladder rather large, its coats much thickened, and its
   muscles so developed that they formed prominent
   projecting bands on its internal surface, much like
   the fleshy bundles on the interior of the ventricles of
   the heart.
6. Ureters dilated—in places, to the size of the little finger.
7. Infundibula and pelvis of both kidneys greatly dilated,
   and the state of sacculated kidney evidently in process
   of establishment. Left kidney of natural size. Right,
   one half larger and of darker colour. Both showed
   depressions along the surface marking the interlobular
   portions. Previous to section, the cones could be
   distinctly felt as much denser than the interpyramidal
   portions, giving indeed the sensation of so many little
   tumours or nodules. On section, both were seen to
   be pale and flaccid, and evidently undergoing a gradual
   process of absorption.

The other adult patient is the subject of the case reported
above, and he, as will be observed, has been greatly benefited
by a prolonged course of steel.

What is diabetes insipidus? or rather that form of it which has been termed by authors, hydruria, poly-dipsia, and chronic diuresis?

Dr. Barclay, says of it, " at present it does not appear that any logical view of its cause has been suggested."

Dr. Beale says, " I do not think that the condition is sufficiently well characterized to give to it the title of a distinct disease; I believe it depends merely upon a large quantity of water having been taken."

Dr. Christison says, " the nature and cause of this form of disease are obscure. The most generally received doctrine regards it as fundamentally an affection of the organs of digestion producing inordinate thirst, and consecutively diuresis; but the nature of the primary disorder is unknown."

Becquerel and Rodier are of opinion, " that this is a disease entirely constituted by an aberration of the sense of thirst, which is, for the most part, greatly increased. The amount of water is greatly increased, while the solid matters remain for the most part, almost unchanged."

Dr. Hughes Bennett thus comments upon a case of this disease:—" I prefer calling this case polydipsia to diabetes insipidus, as frequent careful inquiry established the fact that it commenced with thirst, and that the increased flow of urine was a simple result of the quantity of water drunk."

Dr. Prout says, " my belief is, that it is often connected with, or leads to, incipient disease of the kidneys."

Dr. Watson says, " some of these cases appear to depend upon excessive thirst, arising from an unhealthy state of the mucous membrane of the pharynx, and are apt to end in phthisis."

Dr. Willis thus writes of it:—" In the present state of pathological knowledge it is impossible to say upon what peculiar morbid condition of the system generally, or of the kidney particularly, the elaboration of a large quantity of watery urine depends. I have no hesitation in saying, however, that it is intimately connected with the nervous temperament. All who have suffered from it, within the sphere of my knowledge, have been men of mind, possessed of keen sensibilities and highly impressible nervous systems."

From these quotations it will be seen that the opinion of most modern authors is to the effect that the affection is sometimes merely a habit, and that always the diuresis is secondary, and a result of some other and primary disorder, which resolves itself into a depraved condition of the mucous membrane of the pharynx or stomach causing inordinate thirst. This, however,

is not a sufficient or final explanation, since the further question immediately arises, To what is this disorder of the mucous membrane itself due ?

The analysis of the urine given above differs but little, if regard be had to the respective specific gravities, from one by Dr. Beale, published in the number of the British Medical Journal, for 17th September of the present year. It is chiefly remarkable for the large percentage which the urea forms of the total solid matters, though the absolute quantity of the urea and uric acid excreted in the twenty-four hours would appear also to be somewhat diminished ; and both tend to show that this disease is not a disease of the urine, so far at least as that there is no great excess or deficiency of any of the ordinary urinary constituents, and no addition of any superadded morbid material which the usual chemical and microscopical tests can discriminate. Whether, however, the diuresis may not be due to the presence in the blood of some subtle unrecognized diuretic material, or to some depraved innervation with exalted functions of the malpighian (water-secreting) portion of the kidney,—the result being a condition, as expressed by Dr. Willis, "in which the kidney is not at work to drain the system, but the system is at work to supply the kidney,"—is, I think in the present state of our knowledge, fair matter for speculation. However this may be, certain it is that the effects of the disorder, both secondary and tertiary, are very analogous to those produced by diabetes mellitus, and consist essentially of depraved nutrition and its results, with a gradual exhaustion of the powers of life.

Many of the cases recorded by Willis and others, under the name of diabetes insipidus, appear to be, and they doubtless are, merely examples of diuresis accompanying an abnormal habit of imbibing large quantities of liquid, yet others are as certainly cases of real, distinct *disease*,* for it appears impossible to believe that an affection, which can come on in an adult, or in one already in the decline of life (as in one of the cases related above), which can steadily and gradually exhaust and finally destroy the patient, in the short space of eighteen months, without leaving any other appearances than such as are due to anœmia, emaciation, and continued irritation of the

---

* Understanding by this term something more than a simple aberration or increase of the sense of thirst, with the resulting increase of the urinary discharge. The tendency of all recent researches is to show that diabetes mellitus is due essentially to disorder of the nervous system, especially of that portion which is located in the cervical region of the body, and if so, the similarity of the two affections in their symptoms and course is, I think, sufficiently great to justify a supposition of an analogous origin.

bladder—can be due merely to exalted thirst, or to the habit of drinking an excessive quantity of fluid.

One other point to which I would merely allude is the recurrence of the diarrhœa, which was a marked symptom in both my adult cases. This may, of course, be simply a mechanical phenomenon, due to a periodical effort of nature to remove the constantly recurring constipation, but it is also susceptible of another interpretation, and may be well explained by the hypothesis, that some morbid material continued to form in the blood which the kidneys were attempting to remove, but which after accumulating to a certain extent, was then got rid of by another outlet, namely, the mucous membrane of the bowels.

NARRATIVE OF A CASE IN WHICH MALFORMATION OF THE PULMONARY VALVES GAVE RISE TO REMARKABLE CARDIAC SOUNDS.

BY J. WARBURTON BEGBIE, M.D.

AT a meeting of the Medico-Chirurgical Society of Edinburgh on the 16th of November, 1859, Dr. Haldane, Pathologist to the Royal Infirmary, exhibited a heart which had been removed by him from the body of a patient on the 14th of the same month. In examining this heart, the valves of the pulmonary artery were tested by a stream of water, and were found to be slightly incompetent. There were four valves, three of about the ordinary size, the fourth much smaller than the others, and imperfectly separated from one of them. The other valves of the heart were healthy, and the organ was of its natural dimensions.[*] The heart, the description of the abnormal appearances in which I have given very nearly in Dr. Haldane's words, was that of a young man, who for a period of nearly three years had been under my observation, whom I had, times without number, occasionally alone, more frequently in the presence of a clinical class in the Infirmary, examined; and from the date of the first examination, at the commencement of 1857, had believed to labour under some abnormal condition of the arterial valves on the right side of the heart.

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[*] Proceedings of Medico-Chirurgical Society, Edinburgh Medical Journal, December, 1859.

W. W., æt. 18, consulted me in the very early part of 1857,
chiefly on account of a slight degree of difficulty in breathing,
aggravated on making any forced exertion. In reply to my
careful inquiry he stated that he had always considered himself
to be "touched" in the breathing, having observed, from his
earliest recollection, that he could not run with the same facility
as other boys, and that on lifting heavy weights he was very
soon fatigued and caused to "pant."

At eighteen when I first saw the patient, he had no appear-
ance of suffering from bad health, was then able for the duties
of a light porter, and admitted that he applied for medical
advice from no feeling of increase in the difficulty of breathing
and slight palpitation which from boyhood he had suffered, but
in the hope that these his old symptoms might be subdued.

When W. removed his clothes to permit a careful exami-
nation of the chest, I was struck by the peculiar appearance of
the right arm; it was much shorter and thinner than the left,
a condition which he stated had existed from birth. The left
arm was well developed. He was, it is scarcely necessary to
add, left-handed. On inspection of the chest a more ample
clothing by the pectoral muscles over the left than the right
front was at once apparent. Besides this, there existed a
decided prominence in the cardiac region. Impulse of the
heart, without being decidedly exaggerated, was readily appre-
ciable. Rhythm of heart natural. Apex beat was detected in
the normal situation, and there existed no increase of pre-
cordial dulness. A very decided thrill accompanied the systolic
action of the heart, when the hand was applied over the base.
On more careful examination, the thrill was found to be almost
entirely limited to the situation in which a loud systolic murmur
was heard with the greatest degree of intensity. That was at
the left border of the sternum, over the cartilage of the third
rib. The systolic murmur thus distinguished was blowing in
character and of an unusual loudness; in the same situation
it was followed by a diastolic murmur of much less intensity.
The systolic murmur was readily distinguished over the whole
upper part of the chest, but with much facility the seat of
its greatest intensity was determined to be that already indi-
cated. The diastolic murmur was limited or almost limited
to the same situation. Over the aortic valves something
like the normal second sound was from time to time audible.
The loud systolic murmur was not propagated in the course
of the systemic circulation, for though loudly heard over the
upper sternum, it was scarcely appreciable in the carotids.

The radial as well as other superficial pulses were normal, no jerking character or trace of visibility distinguished them. The strength of pulse good, average frequency 74. Respiratory murmur of both lungs was feeble, otherwise unaltered. Patient had never suffered from rheumatism, had never spat blood, had little or no cough, and no expectoration. Complained occasionally of drowsiness. Had no appearance of lividity of the countenance. Subsequent to this my first examination, he was on three occasions under my care in the Infirmary, once in 1857, and twice in 1858. Repeatedly examined, the physical signs underwent no change, so that in the notes of his case, I frequently find this remark, " physical signs precisely as before." The slight breathlessness he suffered was always relieved by the care and comfort of hospital residence, and the palpitation which seemed in great degree functional, was always mitigated by attention to the state of the bowels, proper regulation of diet, and on one or two occasions when more severe and lasting than usual by the application of a Belladonna plaster. By iron and henbane, which he took for a lengthened period, both when in the hospital and out of it, he stated that he always felt himself benefited.

He left the Infirmary for the last time on the 5th of October, 1858. I had then been successful in obtaining employment for him of a light nature; at this he continued for a considerable period. I saw him frequently thereafter; there was up to the very last occasion on which I accidentally met him in the early summer of 1859, no change in his appearance, and he always expressed himself as feeling as well as on any former occasion. For several months I had not seen him, when on Sunday the 13th of November, on visiting the Infirmary, I was startled by the announcement from the nurse—under whose charge in the hospital he had been on the occasions alluded to in this narrative,—that his body was then lying in the dead-house. On inquiry, I was grieved to learn, that during the afternoon of the preceding Friday, when in a state of intoxication, to habits of which he had only lately become abandoned—he had fallen down a stair, and had been brought to the surgical hospital, where, upon examination an extensive fracture at the base of the skull was detected. He died the same evening in a state of complete insensibility. It was in the performance of the post-mortem examination to determine the precise nature of the injury of the head, that the opportunity occurred for observing the state of the heart.

This interesting case may be almost left without any comments, on one or two points only I am tempted to make a few remarks:

1. The physical signs seemed to me from the very first examination to indicate a lesion of the pulmonary valves, one which offered some obstruction to the flow of the blood outwards from the ventricle, and at the same time permitted the reflux of blood backwards to a limited extent. The obstruction I argued could not be very great, as there existed no evidence of hypertrophy of the right ventricle, nor any signs of imperfect supply of blood to the lungs. The loudness of the systolic murmur seemed to bear out the doctrine of Dr. Hope, that pulmonary murmurs, from the greater nearness of the pulmonary artery to the surface of the chest, are likely to be louder than aortic murmurs. Equally strong indications of the pulmonary origin of the murmurs, as the precise situation in which they were most clearly heard, were the want of propagation in the aortic, and large vessels, or along the sternum, and the absence of any peculiarity in the superficial pulses. The incompetency of the pulmonary valves I considered to be only to a limited extent, from the faint character of the diastolic murmur and the absence of any marked pulmonary symptoms.

2. The history of the patient's case, the fact very specially, that throughout life, his breathing had been slightly affected; that he had never suffered from rheumatism, and his appearance, with the shortened right arm, made it not improbable that the cardiac lesion whatever it might be was of fœtal origin.

3. Lastly, the absence of any other form of valvular disease, in this case, may reasonably be considered as having materially simplified the diagnosis, though its interest cannot be considered as on that account, in any degree diminished.

CASES ILLUSTRATING THE USE OF THE OPHTHALMOSCOPE.

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AND

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Case 5.—Martha Hollis, aged 20, a girl, of a brown, sallow complexion, vacant expression, and dull intellect, applied October 20, 1858. With the exception of frequent fits, to which she had been subject for some years, her general health was tolerably good. Catamenia regular, urine healthy and normal;

she occasionally passes lumbrici. She complains that the sight of the right eye began to fail her about two years ago, and has been gradually getting worse up to the present time. She is now perfectly blind of the right eye, and cannot distinguish light from darkness; the sight of the left one is also impaired, but she can read large type with it (great primer). On examination, the conjunctiva and sclerotic appear healthy. Palpation normal. Some lachrymation with a trifling mucous discharge. Both pupils fully dilated. There is external strabismus of the right eye. No pain or other subjective symptoms accompanied the gradual loss of sight.

OPHTHALMOSCOPIC EXAMINATION.—Plate 1, Fig. 1.—*Right Eye.*—Cornea, lens, and humours clear. The optic disc is of a pure, glistening white, circular, of normal size, and well-defined edge. No shadow of bulging or cupping is reflected from its uniform flat white surface. Four small retinal vessels enter and leave its centre, taking their ordinary course. The choroid around the optic disc reflects a bluish grey shade, which gradually fades into a somewhat pale red, the vessels being dimly seen; two or three spots of pigment are deposited below the optic disc. Over the situation of the macula lutea, fig. 2, is a patch of effused blood, apparently proceeding from a rupture of the choroidal vessels; around this are three other distinct, well-defined, blue deposits, with yellowish centres, elevated, and capped with spots of black pigment.

N.B.—The blue deposits are rather too well defined at their edges by the chromo-lithographer.

Ophthalmoscopic examination of the left eye, shows the same appearance of the optic disc, but over the macula lutea is an increased state of vascularity of the choroidal, but not of the retinal vessels.

The treatment consisted of a combined tonic and purgative plan. Iron, with an occasional mercurial purge.

SECOND OPHTHALMOSCOPIC EXAMINATION, February 2, 1859. —*Right Eye.*—The appearances of the optic disc and of the blue spots remain the same, but the patch of effused blood is absorbing, and a dark hazy shade is all that is to be seen. In the left eye also the vascularity over the same spot has almost entirely disappeared. The state of vision, however, remains much about the same.

The history and ophthalmoscopic appearances of this case seem to indicate cerebral disease. The blue spots seem clearly to be the remains of unabsorbed blood clots.

Case 6.—Mary Jones, a drunken, dissipated woman, received a blow on the right eye one evening in a quarrel. Next morning on awakening she found that the sight of the eye was so much injured that she could only distinguish the outlines of large objects, and that with difficulty. A few days afterwards she applied at the hospital, vision remaining in the same condition. There was no external appearance of injury, except slight discoloration around the eye from the blow.

Ophthalmoscopic Examination.— Plate 1, Fig. 3.—The fundus of the eye was of a much brighter red than usual, from choroidal congestion. The optic disc was of a rosy red hue, owing to which, and to the heightened colour of the choroid, its circumference was not so sharply marked as in the healthy eye. There was no change in the retinal vessels. A little to the inner side of the optic disc, and near its margin, lay a clot of blood of a somewhat crescentic form, deep red, almost approaching to black in the centre, gradually shaded off to bright carmine at the edges.

No special treatment was considered necessary. The blood was gradually absorbed, and in proportion as this took place vision returned. It was remarked that as the clot diminished in size, it assumed more and more the circular form, suggesting the idea that this might possibly be the process of formation of certain peculiar spots, which have been occasionally observed at this hospital, and probably also elsewhere. The spots in question are very dark brown, almost black, shaped somewhat like a quoit, being circular in form, with a bright, nearly colourless spot in the centre. No opportunity was afforded of ascertaining the correctness of this idea, as the patient discontinued her attendance when the sight was almost perfectly restored, but before the changes in the clot had ceased.

Before the discovery of the ophthalmoscope, the diagnosis, prognosis, and treatment of this case would have been alike matters of conjecture. In former days loss of vision resulting from a blow, where no external injury was visible, was commonly attributed to " concussion of the retina;" a vague expression to which no definite meaning can be attached, and which did not permit the surgeon to rest satisfied without submitting his patient to the usual routine treatment of leeching, blistering, and mercury. In this case the ophthalmoscope at once revealed the nature of the injury, the probability of perfect recovery, and the absence of any necessity for special treatment. It appears probable that in the great majority of similar accidents equal certainty may be arrived at by the use of this invaluable instrument, and the diagnosis and treatment thus rescued from the realms of uncertainty.

Case 7.—Mrs. Ancell, æt. 61, applied December 15th, 1858.—About five years ago, she received a smart blow on the right eye-ball from the handle of a saucepan. The pain, which at first was very acute, subsided in the course of the day ; but from that time the sight began to fail, and has become gradually worse and worse. She has not had any regular medical treatment, and has only applied now because the vision of the left eye has, within the last few months, become seriously impaired. In neither eye has there been any pain during the progress of the symptoms ; in the right eye, she has for the last two years been occasionally troubled

with floating muscæ, but has never had flashes or sparks of light; in the left, she has frequent, faint flashes, and the eye is slightly intolerant of light. There is no external appearance of disease, and both eyeballs are of normal consistence.

When the head was held downwards, so that the eyes were turned slightly upwards, she could, with the right eye distinguish the face, but not the features, of a gentleman sitting about four feet from her, and could even see a small gold watch chain, which hung across his dark coloured vest. On looking straight forwards, the dim outline only of the figure could be seen; no details could be made out. Objects seen with the inner and upper part of the retina, seemed as though broken in two. With the left eye she could make out type of the size used for the *date* of the "Times," but in a few seconds the letters seemed to run together and become confused, so that she was quite unable to read.

OPHTHALMOSCOPIC EXAMINATION.—*Right Eye.*—Plate I., Fig. 4.—The superficial choroidal pigment has been almost entirely removed, exposing the net-work of orange coloured vessels as distinctly and sharply marked as in a well injected specimen of the intestinal capillaries, which they much resemble in appearance. A broad band of brilliant white, extremely irregular in form, crosses the fundus of the eye transversely, surrounding the optic disc, and narrowing towards the inner side, where the vessels of the choroid again begin to appear. In this space the choroid is completely atrophied, and the white appearance is due to the sclerotica, shining through the diaphanous membrane. Masses of pigment, irregular in form, and jet black in colour, are dotted over the fundus of the eye. The optic disc is of dark grey colour, deeply shaded towards the margin. For about two-thirds of its circumference, it is surrounded by a line of jet black pigment. The retinal vessels are distended, and the arteries cannot be distinguished from the veins by their colour. At a little distance beneath the optic disc are two small spots of a greyish colour, and woolly, flocculent appearance, probably small masses of effused lymph. One of these is situated in the course of an arterial branch, which passes beneath it, and is concealed during its transit.

The appearances in the left eye are of the same general character as those in the right, but in a much less advanced stage.

Case 8.—William Brine, æt. 12½, applied April 27th, 1859. He had been a weakly boy during infancy, but at present he enjoys tolerably good health. His left eye, ever since he can remember, has been very deficient in sight. He can now hardly discern the hand passed before his eye. He has never had any acute inflammatory attack in his eyes; neither have they ever given him any pain. To external examination and palpation, the eye is healthy. On trying him with glasses N. 13, biconcave, he can see better, so as to distinguish the fingers on a hand held before him.

OPHTHALMOSCOPIC EXAMINATION.—*Left Eye.*—Plate I., Fig. 5.—The centre of the optic disc is thrown into relief by a light pinkish shade, the circumference towards the temporal

side is thrown into sharp outline by a dark shade having a defined lower edge, which is reflected from the pigmental layer of the choroid. On the nasal side, the white crescent, of so frequent occurrence in myopic persons, is here very evident. The retinal vessels cross the crescent transversely, and appear by the alteration in their shade and diameter to dip into a concavity as they pass over it. Small vessels arising at the edge of the optic disc also pass across it, and some few whose origin is only to be traced from the extreme edge of the crescent. The sclerotic is generally thinned and slightly staphylomatous at this crescentic part; this condition has been called "posterior staphyloma," altering the antero-posterior axis of the eye, may give rise to myopia; however, many myopic patients do not show this crescent at all.

The choroidal vessels are more plainly shown in this eye, the pigmental coat being generally deficient.

Case 9.—Lewis Marks, a Jew, applied March 24th, 1859. The right eye had been destroyed by previous disease some years ago. The left (Plate I, Fig. 6) is almost useless from excessive myopia, the use of the most powerful biconcave glasses only enabling him to find his way about the streets. This has been the case as long as he can remember.

OPHTHALMOSCOPIC EXAMINATION.—*Left Eye.*—This showed a remarkably small optic disc, with considerable hyperæmia of its surface, especially towards the temporal side. The retinal vessels which enter are few, and very minute. On the nasal side of the optic disc is a small white spot, with one small vessel running across it. Query, whether this is crescentic, or is it deposit?

Congenital atrophy of the optic disc and probably also of the retina is diagnosed here.

NOTES OF CERTAIN CASES TREATED AT THE ROYAL WESTMINSTER OPHTHALMIC HOSPITAL.

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I. *Gonorrhœal Ophthalmia under Stimulant and Supporting Treatment.*

Case 1.—Elizabeth Bannister, æt. 18, admitted under the care of Mr. Hancock, November 18th, 1857. Right eye affected. Enormous swelling and bluish-red discoloration of lids. Abundant secretion of thick yellow pus. Cornea opaque. Intense chemosis encroaching on about one third of the extent of the

cornea. Vision absent. Suffers acute shooting and aching pain. General health good.

Origin of disease—She is a servant in a family where three children are suffering from an affection of the genitals. A towel which was used by a brother having the venereal disease, and subsequently for the children, seems to have been the cause of communication of the virus to the latter. She has lately wiped her eyes with a sponge used by the children.

Duration of disease until application.—Five days.

Treatment.—℞ Quinæ disulph. gr. ii, Opii gr. i ter die. Meat diet daily, and a pint of porter. Eye to be frequently cleansed with decoction of poppy heads, and a drop of solution of nitrate of silver (gr. vi ad ʒi) to be introduced every morning.

Progress.—Five days after admission left eye also became affected. Nitrate of silver sol. (gr. x ad ʒi) was introduced. Then by Mr. Hancock's order all local stimuli were abandoned. Hydrarg. Chlor. gr. i was added to each pill. Porter exchanged for wine. 13th day of disease :—Intense pain of right eyelid. Delirium. Ordered a mixture containing ammonia and bark, and to continue the wine. 19th day :—Delirium ceased. Discharge from eye less. Chemosis of the left eye has disappeared. Cornea perfectly clear; vision good; still much conjunctival redness. Right eyelid less tender when touched, but much swollen. 34th day :—Left eye almost normal. Right eye-ball disorganized. The left eye soon regained completely its healthy condition.

Case 2.—John House, discharged soldier, admitted February 10, 1859, under Mr. Hancock, for granular lids. He can just see to get about. The granular state of the lids was for eight days combated by the application of sulphate of copper ; then it was noticed that they had a quasi-erysipelatous swelling. Omit cupri sulph. and bathe constantly with warm water. 3rd day of disease :—Cupped to ʒij from each temple. Calomel and opium. 7th day :—It was discovered that he had gonorrhœa; he had previously stoutly denied this. Discharge very profuse ; much pain of left eye.

Treatment.—Ordered meat diet. Oj of beer. Quinæ disulph. gr. ij, Opii, gr. j, *4tis* horis. Eyes syringed out every ten minutes with Decoc. papaveris. 14th day :—Right eye doing well ; cornea almost clear. 16th day :—No chemosis of conjunctiva of right eye ; cornea clear ; left chemosed and evidently the worse. 29th day :—Right eye, vision good ; in very favourable condition. Left, painful ; cornea dull. Solution of nitrate of silver (gr. j ad ʒj) applied every morning. 30th day :—Left eye worse ; punctured by means of a fine point of lunar caustic. 44th day :—Vascular staphyloma of lower part of left cornea. Staphyloma was gradually subdued by means of lunar caustic. On the 50th day, the prominence was very slight, and on the 70th day, he was discharged cured, right eye being completely saved.

Case 3.—John Few, æt. 21, admitted March 15. Both eyes affected ; left lids more swollen than right. Left eye : cornea dull, conjunctiva chemosed. Right eye : cornea clear, chemosis slight. Separation of the lids discloses thick yellow purulent secretion.

Origin.—A month or six weeks before admission had gonorrhœa ; discharge continued after entry. Seven days before admission noticed that lids of left eye were agglutinated and yellowish white discharge extruded. Following day he was unable to see with it. On the third day after the commencement, the right eye began to be affected in the same way. Suffered much in the left eye.

Treatment—Meat diet with a pint of beer. ℞ Quinæ disulph. gr. ij, Pulv. opii, gr. j. 4tis horis. Eyes to be well washed out frequently with decoction of poppies.

Progress of Case.—Soon the upper part of the cornea of the left eye appeared sloughy, and there resulted an uneven staphyloma. The cornea of the right kept perfectly clear. 15 days after admission the right eye was nearly well. The left iris protruded, and was touched with a point of Argent. Nitras.

29th day :—Left eye totally disorganized, but no active inflammation whatever taking place. Right eye in excellent condition. 32nd day :—Discharged.

Case 4.—John Maltby, æt. 20, admitted August 20, 1856. Left eye affected ; lids very much swollen ; copious purulent discharge, and much pain.

Treatment.– Similar to the former. Eye frequently washed with a weak solution of nitrate of silver. He was discharged cured on the 23rd day after admission.

Case 5.—Ann Keeley, æt. 19, admitted November 4, 1856. Left eye intensely red ; interstitial deposit between the layers of the cornea had taken place. Whilst she was walking up the stairs of the hospital the cornea gave way.

Origin.—Suffering from gonorrhœa, and accustomed to bathe her eyes with her own urine. At first the local mischief was treated by a general practitioner with sulphate of zinc lotion. The symptoms became aggravated, and leeches were then applied. For a week she continued to bathe her eyes with warm water, and then applied at a general hospital when she was treated by blue pill and lotion of nitrate of silver. Finding herself worse, three days afterwards she applied here.

Duration until application.—About fourteen days.

Treatment.—Double allowances of meat and beer. Quinine. The eye frequently washed out with solution of nitrate of silver (gr. ij ad ℥j). Belladonna applied over the brow. Afterwards the point of nitrate of silver was applied to the ruptured part of the cornea, and slight pressure made thereupon by a pad.

Result.—Eighteen days after admission (about 32nd day of disease) she was discharged to attend as an out-patient. The sight was entire ; the pupil regular ; a small point of the cornea at its lower part was surrounded by a hazy patch, which gradually diminished.

Case 6.—William Laurence, right eye was affected ; subjected to similar treatment to the foregoing ; left the hospital 69 days after admission.

Case 7.—Emma Nelson, æt. 57, admitted December 13, 1856. Right eye ; palpebral and ocular conjunctiva much chemosed, cornea depressed, dull and milky, and almost covered by the swollen conjunctiva. Pupil barely visible ; faint appreciation of light ; great tenderness and pain, and much discharge.

Origin.—Has been nursing a child having purulent ophthalmia, the father of whom is reputed to have gonorrhœa ; thinks she has wiped her eyes with the cloth used for the child.

Duration until admission.—Four days. Two leeches had been applied to the temple.

Treatment.—Local ablution with decoction of poppies, solution of nitrate of silver (gr. ij ad ℥j) ; instilled ; Hydrarg. chlorid. gr. ij ; Quinæ disulph. gr. j every two hours.

Diet.—Beef-steak and arrow-root.

Progress.—Towards evening the pain entirely ceased. Opium (gr. ss.) was added to each powder. *Second day after admission* — Gums slightly sore. 3rd day :—Powders given three times a day. 4th day :—Ol. ricini, ℥ss. statim. To leave off calomel and take quinine and opium. 5th day :— Ulceration apparent at upper part of cornea. 6th day :— Left eye waters, and a pricking sensation is experienced therein. Sol. of nitrate of silver (gr. ij ad ℥i) dropped in. 7th day :—Cornea of right eye gave way and aqueous humour escaped. Iris slightly prolapsed. Pad applied. Left eye : conjunctivæ becoming chemosed ; discharge increasing cornea still clear. 12th day :—Three leeches applied below ciliæ of lower lid ; chemosis rather less ; cornea peripherally hazy. 2nd day :—Cornea less dim ; Chemosis much diminished ; ulceration has taken place at the upper part of the cornea. 24th day :—Opium omitted. Sol. of nitrate of silver (gr. ij ad ℥j) instilled three times a day. 28th day :—Healing of ulcerated cornea taking place. A drop of Vinum opii introduced daily. 32nd day :—Nearly well ;

sight good. Mark of corneal cicatrix very slight. 44th day :—Discharged ; left eye normal; right destroyed.

Case 8.—John Carey, æt. 23, admitted October 13, 1855. Left eye affected ; conjunctiva much swollen ; discharge purulent and copious ; cornea very slightly clouded towards lower part.

Origin.—Sleeping with a fellow-workman, and having some difficulty in procuring water for lavatory purposes, each has been in the habit of washing himself with their mutual urine. The patient, more unfortunate of the two, was after some time affected with severe inflammation of the left eye, and then he discovered that his companion had gonorrhœa. Such is his own account ! He applied bread and water poultices to the eye, and caused himself to be purged with Epsom salts.

Duration before admission.—Twelve days.

Treatment.—Precisely the same as in Case 7. 5th day after admission : —Mouth tender : chemosis much less. The bowels were next freely opened by colocynth and sulphate of magnesia. 12th day :—Cornea presented small ulcers ; aqueous humour escaped; iris prolapsed. Ulcer was touched very lightly with a point of caustic, and extract of belladonna was smeared over the brow. Treatment altered to quinine and opium. 15th day :—Ulcer quite healed. Vinum opii introduced. 20th day :—Sight perfect. He was discharged. He presented himself afterwards as out-patient, when there was seen merely a slight speck at the lower part of the cornea, which gradually became clear.

Case 9.—Joseph Miller, æt. 32, admitted October 17, 1855. Disease had attacked both eyes, both seemed in much the same state. Conjunctivæ much chemosed, cornea hazy. Discharge copious, adhesive, and purulent.

Origin.—He says that it arose from his using a towel belonging to a fellow-workman who had "something the matter with his eyes." But he is a married man and has been absent from home for some time. He had no gonorrhœal discharge at the time of his admission.

Treatment.—Precisely the same as in the last case.

Progress.—Second day:—Mouth slightly touched ; pain and photophobia nearly gone. 3rd day :—Mercury decreased to three times a day ; chemosis diminishes ; cornea becoming clearer. 7th day :—Lotio aluminis substituted for Decoct. papaveris. Bowels opened by Magnes. sulph. 13th day :—Corneal haziness nearly gone. 16th day :—Discharged.

Case 10.—Robert Burnett, æt. 26, admitted January 19, 1816.—Left eye affected. Great tumefaction of lids ; profuse discharge ; extreme chemosis ; cornea totally opaque, at upper margin appearing inclined to slough.

Origin.—Has gonorrhœal discharge.

Duration.—Ten days.

Treatment.—Quinine and opium (gr. ij and gr. ¼) three times a day. Liberal diet and Oij of porter. Fomented with Decoct. papaveris, and orbit occasionally syringed with a weak solution of nitrate of silver (gr. ss. ad ʒi). 2nd day : — Much less swelling; chemosis somewhat less. Ext. Belladonnæ applied over brow; aperients. 5th day : Improvement in every respect. 7th day :—Cornea showing greater tendency to slough ; slight protrusion of iris at upper part. 9th day :—Sloughing arrested ; improvement in the other respects. 13th day :—Iridal protrusion much less. Pupil rather more than normally contracted. Belladonna over brow. 15th day :—Cornea quite clear ; chemosis subsided. 27th day :—Sight steadily improving, and pupil gradually becoming more dilated. Iodide of potassium in 5 grain doses substituted for quinine and opium. 35th day :—Discharged with a capital eye.

Case 11.*—Mary Hatt, æt. 18, admitted June 7th, 1859. Right eye affected. Cornea very opaque ; conjunction very much chemosed, distressing lachrymation.

* See Lancet, for September 17th, 1859.

Origin.—Gonorrhœa.

Duration until admission.—Five days.

Treatment.—Precisely as in Case 10 ; 2nd day after admission, restless, cornea showed tendency to slough. 3rd day :—Delirious, great cephalalgia. Omit opium. 4th day :— Eye syringed with solution of nitrate of silver (gr. ss. ad ℨj). 13th day :—Inflammation decreased, pain less. 18th day :—Cornea cloudy, but all tendency to sloughing has passed away. 20th day :—Begins to distinguish form and colours of objects. 30th day :—Pain and lachrymation ceased. 32nd day :— Sight, she says, is as good as before the outbreak of the disease. 42nd day :—Only remaining sign of disease is mottling of the circumferential part of the cornea. 52nd day :—Discharged cured, slight opacity remains below the axis of vision.

Case 12 *—John R., æt 21, admitted August 17th, 1859. Left eye affected. Lids much swollen. Intense chemosis, but cornea pretty clear.

Origin.—Used the towel of a companion who was suffering from gonorrhœa.

Duration.—Twelve days.

Treatment.—Similar to Cases 9 and 10.

Progress.—3rd day :—So much better, wishes to leave the hospital. 15th day :—Chemosis entirely disappeared, cornea looked slightly soft. A solution of nitrate of silver (gr. ij. ad ℨj), dropped between the lids. 16th day :—Sight perfect, conjunctival congestion fast disappearing, slight mottling of margin of cornea.

The foregoing are abstracts of all the cases of gonorrhœal ophthalmia which have been treated in this hospital upon a stimulant and supporting plan. The general lesson taught by them seems undoubtedly to be that this is superior to the old depleting method. It is rather by the experience of individuals than by statistical argument that this point must be judged, for the latter is not supported by sufficient numbers to establish any valuable conclusions ; Mr. Hancock, the senior surgeon of this hospital, under whose care all the forementioned cases were placed, is fully convinced of the great success of this mild antagonism† of the disease over the old system of combating it with the whole battery of antiphlogistic remedies. The data, too, which we possess, though they are necessarily imperfect point to a similar conclusion. Thus, Lawrence‡ states of 14 cases observed by him, 9 had one eye affected, 5 both. The eye was lost in 6 cases in which one alone was attacked, and of those in which both were involved, both were lost in one instance, and one perished in two cases—one recovered partially and one completely. An analysis of the 12 cases here recorded shows that the disease attacked one eye in 7 instances, both in 5—that in all the 7 instances the eye was saved—and that of the 5 in which both were involved, 4 resulted in the loss of one eye, and one case completely recovered.

It will be observed that the local treatment was gentle, *weak* astringent solutions were employed.

* See Lancet for September 17th, 1859.
+ See *Dixon.* Diseases of the Eye. Page 43.
‡ Quoted by *Er chsen.* Surgery. Page 911.

Certainly the disease carries with it the sight of extreme depression of the vital powers. Added to the local mischief, is the dread of losing the sight, and either the self-reproach of having contracted the first cause or the sense of misfortune in having suffered from another's fault. Thus in cases 1 and 11, delirium was a prominent symptom.

Altogether a marked analogy seems to exist between this and those other acute diseases, in which a plan of treatment tending to support the powers of life has been attended with signal success.*

II.—*Effects of Partial Paralysis of the Fifth Nerve.*

Alfred Stowers, æt 26, admitted July 15th. Tall, but very pale. Served in the army throughout the Crimean campaign, but was discharged six weeks before admission on account of partial paralysis of the left side, accompanied by ptosis. Eighteen months previously, he was suddenly attacked with severe frontal pain not confined to one side; at the same time he experienced dizziness and protracted vomiting. He said that at this time the sight became clouded.

Nine months before admission, pain recurred in the left temple near the eyeball, afterwards it shifted to the eyeball itself. He now began to find that the left side of his face was benumbed; then the left upper eyelid fell, and he was unable to raise it, the same side of the body also lost power. This occurred about five months before his admission; two months afterwards the ptosis ceased, and then he says the lids were retained open, and the globe was drawn to the outside. The conjunctiva became bloodshot, and for this condition a practitioner dropped into the eye some fluid which, he says, immediately caused the cornea to become white, and he was unable to see. Subsequently he recovered the sight in some degree.

Present Condition of the Eyeball.—It is normally exposed and occupies its usual position. The conjunctiva is vividly congested. The cornea presents a chalk-looking film, with a rim of gelatiniform, pale yellow substance intervening between it and the redness of the conjunctiva, and, as it were, supporting it in its surface. This softened material bulges out at its most dependent part. He has faint vision at one point. The tongue, on being protruded, deviates to the left side. The muscles of this side of the body appear slightly atrophied. There is no difficulty of de lutition. He was ordered, strychniæ gr. ss. mist. acid; nitromuriatic ℥viij; capiat ℈j ter die. Gradually the whole cornea was converted into a gelatinous mass, but the general health improved. The conjunctiva became less and less congested. The sloughing cornea was treated by the application of the solid nitrate of silver. He was discharged to return to the country, his eye presenting a greatly improved appearance, on the 12th of August.

Most writers on diseases of the eye have said that sloughing of the cornea from implication of the fifth nerve differs little from sloughing under other circumstances. But this case shows that there are differences, and these are very interesting in a physiological point of view. The appearance of the eye is almost pathognomonic. Mr. Hancock, on near inspection, at once declared the nature of the disease.

(1). *The Cornea.*—In this case the sloughing is due to want of nervous supply, and differs from ordinary inflammatory

* See *Dr. Todd*, " On the Treatment of Acute Disease." Archives, Vol. I.

sloughing in its universality. No commencing of the disorganization at any distinct points of the cornea is observed—it is centripetal. It may thus resemble that rare form of progressive inflammation adduced by Dixon,* but it will differ therefrom in the peculiar condition of the conjunctiva.

(2). *The Conjunctiva.*—It does not present the aspect of ordinary inflammation, although it is highly vascular and sometimes simulates chemosis. There is little or no secretion from it; it looks dry. To the want of this protective secretion which in health keeps the conjunctival surface moist, the changes ensuing on lesion of this nerve have been attributed,† but this is not all. Another effect of the insensibility of the conjunctiva is to permit the introduction, unknown to the patient, of foreign particles into the eye, which yet induce determination of blood without true inflammation. When this patient first came in, there was universal conjunctival redness, the outlines of the vessels could not be seen; but soon much of the redness subsided, and the conjunctiva presented the appearance of passive congestion, the vessels being visible, and turgid with blood. Another potent means of furthering these changes, is the absence of lachrymal secretion; for the gland does not receive its proper nervous supply. Hence there is a wide distinction between this condition and inflammation—there is no pain, sensibility is destroyed—there is no lachrymation, the lachrymal gland does not secrete—there is no discharge, that is not formed when the sensibility of the mucous surface is destroyed.

LARGE STONE IN THE BLADDER CAUSING NO PAIN,

REPORTED BY

R. McCORMICK, ESQ.

House Surgeon to the Bucks Infirmary.

D. G., æt. 45 years, admitted into the Bucks Infirmary, September 8th, 1858, under the care of Mr. James H. Ceely. At the age of 15 years he suffered from pain in the hypogastric region, extending along the urethra to the glans penis, which at intervals during the succeeding twelve months was very violent,

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* Diseases of the eye.   Page 85.
† Carpenter's Human Physiology, 5th Edition.   Page 470.

and was at each attack followed by the evacuation of bloody urine. Occasionally since then he experienced pain in these situations, when taking horse exercise, or during unusual exertions, but *never to any great extent, and he was never compelled to seek advice.*

With these exceptions his general health, although delicate, has been good till last June, when he had an accession of symptoms resembling those mentioned but greatly aggravated. The urine, in addition to blood, containing "gravel." At this time he consulted Mr. Reynolds of Thame, who detected a vesical calculus, and on the 20th September, Mr. J. H. Ceely performed the lateral operation and removed a rough, irregular, mulberry calculus weighing 12 drachms.

During the first 10 days subsequently to the operation, the urine contained considerable quantities of pus and blood, after which time all abnormal characters disappeared, and the patient was discharged perfectly well on the 8th of October, 1858.

The history of the foregoing case is, we believe, not devoid of interest when we consider that the patient enjoyed excellent general health during a period of 29 years, notwithstanding the presence of symptoms unequivocally implying the existence of a calculus during that period. It is not often that we find an organ so sensitive as the human bladder, adapting itself to a calculus so large and irritating as that indicated in the sketch, without giving rise to considerable pain and inconvenience.

Fig. 3.

Mulberry Calculus two-thirds the natural size. From a photograph.

A CASE OF INDURATED TUMOR OF THE BRAIN.

By J. T. ARLIDGE, M.B., A.B., M.R.C.P.

Physician to the Fulham and Hammersmith Dispensary. Formerly Medical Superintendent of St. Luke's Hospital.

CASES of cerebral tumors are of sufficiently rare occurrence, and the pathology of cerebral disorders so far involved in obscurity, that a record of symptoms manifested during life, and traced to a determinate lesion of the brain, detected by an examination after death, must possess a certain value to the medical inquirer.

The following case of circumscribed cerebral induration, or, in common parlance, of cerebral tumor, recently occurred to me in dispensary practice. It was that of a woman, Elizabeth Deane, æt. 36, married, the wife of a labouring man. She had had four children, and one miscarriage. Her complexion was pallid; the expression haggard, and indicative of long-continued suffering. The pulse 80; tongue furred, white, moist, and flabby, protruded but a short distance, as if its muscular power was enfeebled; catamenia absent for twelve months; bowels regular; urine sometimes scanty, at others copious and pale; some leucorrhœa present; frequently experiences a choking sensation in the throat, and palpitation of the heart, and suffers much from flatus. She applied to me, as she had for a long time suffered from " fits," which had latterly become much more frequent, although less violent, and unfitted her for any employment, or the care of her family. I gathered from her that she had a first fit about two years previously; that it lasted a couple of hours, rendering her unconscious, and producing a partial loss of motion of the left side. The paralysis, however, did not last, but the fits continued to recur every three or four weeks, but not at the catamenial periods : they were confined to one half the body, which was thrown into convulsive action.

A blister was applied to the nape of the neck, and after this the convulsions became restricted almost entirely to the left side of the face and neck, but withal their frequency greatly increased. When she applied at the Dispensary these partial convulsions were very frequent : in the course of some fifteen minutes, during which I was engaged in examining her case, three paroxysms occurred, each lasting about three minutes. They seized her suddenly whilst speaking, and were first noticeable about the mouth and eye, and rapidly extended over the half of the face, and the upper portion of the neck, producing a striking distortion of the features. The several facial muscles were spasmodically contracted; the mouth was drawn downwards and outwards; the orbicularis palpebrarum acted forcibly, and the eye was everted. At the same time the whole head trembled, and was slightly inclined towards the left shoulder, and there was some suffusion about the face, and watering of the affected eye. The convulsive action was not rigid but tremulous, the lips and eyelids twitching or vibrating rapidly. Its onset was so sudden as to interrupt the enunciation of a short sentence, and so unimpaired was the consciousness, that, after the transition of the paroxysm, the broken sentence was resumed by the patient; the interruption and the tremor of the lips resembling much the break down in speech and the nervous efforts of a stammering person to resume his discourse.

The pupils of the eyes were unaffected, as was likewise the pulse; and no excitement of the heart could be felt during the paroxysm. There appeared some constriction about the larynx, but the respiration was not impeded. The mental powers were unaffected.

The patient had not suffered from convulsions in infancy, but when she reached adult life, she became subject to severe headaches on the right side, which, just prior to the first fit, and, subsequently to the present date, grew more unbearable, and attacked her at times so violently as to make her shriek with the pain.

Previously to her applying for my advice, she had been under the care of a medical man at intervals, and from him I learn that nothing appeared to relieve the intense pain in the head so much as iodide of potassium. Latterly, more especially, her general health was so much enfeebled, that he prescribed for her tonics with occasional aperients, and ordered her nourishing diet and wine.

I saw this patient but on the one occasion, when I registered her case. I then prescribed for her an aloetic pill at night, and a mixture of quinine with sulphate of magnesia, and ordered her a blister behind the left ear. Two days after she had seen me she was attacked in the evening with a strong fit, in which she lost her consciousness and was generally convulsed. Before this fit had passed by a second occurred, and was followed by coma with dilated pupils, and death.

A post-mortem examination of the head was made about 48 hours after death. Head well formed : no external injury discoverable. The scalp was peculiarly dry and naturally separable from the cranial bones : these were of the average density and thickness, and, in the line of the longitudinal sinus, deeply hollowed by large pacchionian bodies, which projected through the dura-mater, and well nigh perforated the parietal bones at some points. There was no abnormal adhesion of the dura-mater to the cranium, but its sinuses were turgid with dark venous blood. In raising the dura-mater from the brain, it was found inseparably adherent to the cerebral matter, over a rounded space of about three-quarters of an inch in diameter, and could only be detached by tearing the brain substance. A very slight milky opacity was remarked over much of the arachnoid covering the vertex, an appearance however due in a great measure to a small amount of subarachnoid fluid in the meshes of the pia-mater. This last membrane was venously congested ; and on cutting into the brain the same venous congestion was indicated by the very numerous and large bloody points.

The cortical substance was well coloured, did not tear by the detachment of the pia-mater, and presented the usual secondary laminæ, or bands ; of which the principal white one was very distinct. The white matter was of normal firmness ; the ventricles healthy, containing a very small quantity of serum, and the choroid plexuses not congested, but, on the contrary, rather anæmic.

The only lesion discoverable in the brain was beneath the superficial space to which the meninges were adherent. Here there was some loss of substance, a hollow space existing larger than could have been caused by the fragment abstracted in the detachment of the membranes. At the same time the brain tissue was softened at this same part, which was situated in the right hemisphere, near the line of junction between the anterior and middle lobes of the brain, or at a point corresponding with the termination outwards of the sylvian fissure. On slicing the hemisphere from above downwards, a portion of denser, firmer tissue, was cut down upon just below the level of the roof of the lateral ventricle, of an inch in diameter, internally coloured of a deep blackish brown, not so, however, uniformly. Some of the surrounding cerebral substance was softened, but the diseased portion could not be isolated, nor its boundary defined. From its position, the morbid tissue was in relation on the internal aspect with the corpus striatum whilst its

external surface reached, as before noticed, the surface of the brain.

A microscopical examination of a section of the morbid mass exhibited the characters of no specific pathological lesion. It could not be identified either with tubercular or cancerous disease; probably its relations were rather with the former. Its constituent elements were nucleated and slightly granular cells, having considerable refractive powers, and particles of fibrous tissue.

ORIGINAL RESEARCHES IN ANATOMY AND PHYSIOLOGY, AND MORBID ANATOMY AND PATHOLOGY.

ON GRANULATION AND THE PART IT PLAYS IN DISEASES OF THE JOINTS.

By Richard Barwell, F.R.C.S.E.

Assistant-Surgeon to Charing Cross Hospital.

PHYSIOLOGY has of late years received a large supply of facts, and great increase in power of arriving at just conclusions from its branch science histology; but it is doubtful whether pathology has profited as much by these additions as could have been expected. It appears that Morbid Anatomy might very advantageously become more and more histological in its character. There is no lack either of ability or industry in compiling the facts of diseased appearances; but the ground which Morbid Anatomy occupies is much restricted to the changes of special organs, and a more general, connected, and logical way of looking at many diseased appearances would, it seems to me, lay open a wider field for particular research.

Now, if we take the simplest example possible of disease, one of which we know the cause and extent—namely, wounds —and contemplate their mode of healing (putting aside agglutination, or by first intention), we shall be struck by observing that wounds of certain parts become united, or filled up with the same tissue. Other parts, however, are incapable of repairing a loss of substance by like material; they fill up such breach by the substitution of some other texture. Considering these facts, and the differences in the many organs of the body, we shall find a curious relationship of events, which ought to be observed.

Certain organs have intrusted to them a peculiar function necessary to the life of the body; others have what may be called the general function of connection and of support; these latter were classed by Donders, of Utrecht, under the head of Bindegewebe *Anglicé* connective tissues. To the first class (the

special) belong nervous, muscular, and glandular* tissues—the functions of these parts are performed by means of that organic example of a simple machine, the cell. The nervous power is formed by means of cells, which have filled themselves with a special material. Muscular power is produced in the same way, for in whatever manner we consider muscle the position remains, that the *sarkos* is stored in cells; all secretion is produced by cells, which absorb, and then give up the material to be secreted. In examining the properties of any one of these cells, we find that besides its special function, dependent upon its contents, it is capable of maintaining its own nutrition; but not of producing any germs for the formation of new cells. To begin with the plainest example : the red blood cells have absorbed a special material which enables them to assume the function of respiration, but they loose their generative powers, and a special organ (probably the spleen) is destined to form new blood cells ; but the white corpuscles have not taken upon themselves any function beyond that of ordinary cells, and they retain the vegetative faculty. The epithelial, or epidermic cells, are constantly being cast off at the free surface, and new germs, producing new cells, grow (in a way we cannot fathom) from the basement membrane, not from germs, which the cast-off cell gives up at its death. Tubular glands form their secretion in cells, which, bursting, give up the products of their life into the tube, and fresh cells sprout from the tubular basement membrane, not from germs scattered by the rupture of the deceased cells. The same structures, which store the muscular element die or deliquesce, when they have worn out their functional power ; a new pabulum is supplied by the blood, the cell itself leaving behind it no germ for a new formation. The same may be said of the brain, in fact, when the cell has been occupied by any substance, intended to carry out a special function, it looses its generative power.†

The connective tissues are bone, cartilage, cornea, fibrous (ligament, tendon, and fascia), and areolar tissue. Of these, the cell is a constituent part, but it does not contribute to their hardness, elasticity, or toughness, whereon the value of the part depends. The material producing these qualities is fixed *not in,* but *around* the cell in the intercellular, or hyaline substance, the cell having simply to maintain the nutrition and

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* With this last are classed the skin and mucous membranes, because they really perform the glandular function, and because it is not possible to show sufficient structural difference to warrant placing them in a separate category.

† The reader is requested to receive this statement for the present, without further proof, which will be given hereafter.

integrity of the part, and being itself free of the characteristic material of the tissue, probably is filled with the common albuminous contents, which permits to the body the common cell-functions, without adding another to them.

Bone tissue is permeated by a number of vessels, around which are arranged in a circular form so-called lacunæ—namely, intervals, or gaps, in the hard substance, which have a number of minute branches running to the vessel on one side, and from it on the other, dividing thus the tissue into innumerable small spaces. Messrs. Tomes and Campbell de Morgan* have named each of these circlets of cells, with its central canal, an Haversian system, and have shown that each lacuna is occupied by a cell, each branch by a membrane, and that the Haversian canal is lined by membrane. Moreover, they have pointed out the mode in which the nucleus of the bone cell may be seen without any preparation—viz., by observing it in one of the thin lamellæ which inclose the cancelli at the spongy end.

It is easy to get a section of articular cartilage, and to observe therein how the structure is in part composed of oval corpuscles, which contain each from two to five nucleated cells, near the attached part, while, by the division of these bodies, the cells are as a rule separate near the surface. It is also easy to detect the nucleus, the intercellular substance is translucent, and the structure is more easily seen than in bone.

The cornea is, according to Professor Hiss,† made of transparent substance, among which are arranged lineally stellate cells. Virchow has in his *Cellular Pathologie* two plates, which represent this structure very well; the cells are pretty closely packed, and intercommunicate by opposing rays. Mr. Canton, whose investigations on the "arcus senilis" are already so well known, is carrying his researches further, and will, I believe, add his valuable testimony to the above statements.

The white, fibrous, inelastic tissues, ligament and tendon, consist of bands of fine fibres, running parallel to each other, among which are arranged long spindle-shaped cells, that at first look only like accidental spaces between the fibres. The most satisfactory way of studying ligament is to take the internal crucial ligament of the knee from some of the smaller birds (the younger the better); this is in them a thin flat oblong riband, which can easily be detached from both ends and preserved in fluid. Tendon is best examined in similar small creatures, or it may be conveniently studied in the *Palmaris Longus*, or *Plantaris* tendon of man, which can be pulled out

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* Philosophical Transactions.   † Ueber den Bau des Hornhauts.

very thin, and afterwards tortured with needles. The long fusiform cells in these structures are then not only distinctly seen, but are found to be nucleated.

On the structure of areolar tissue we must pause a little longer; it is best seen as it underlies the mucous or serous tissues, and, when one of these membranes be pulled from the underlying structures, the submucous or subserous tissue is to be seen uniting them loosely, as a delicate film, among which a few white fibres are visible. Examined by the microscope, it is seen to consist of the two elements of fibrous tissue—namely, the white and the yellow—the former appears as bands of minute wavy fibres, the latter more rare as thicker branching fibres, having, whenever broken through, a remarkable tendency to curl up. Virchow finds, that where this tissue sends off branches, is situated a stellate, nucleated cell, the branches being but prolongations of the rays of the star, and he believes that the fibres are tubes carrying a nutrient fluid; this tubular character requires more proof; but of the existence of stellate cells there is no doubt; but in many instances they appear isolated. The point, however, which is more important for our present purpose, is that among the white fibres are seen on the addition of acetic acid, many cells, and a large number of nuclei, and, in the meshes of the yellow, a quantity of these bodies, as well as a great many nucleated cells of remarkable clearness and beauty. This tissue is usually prepared for examination, by tearing it to pieces with needles in water, whereby many of the above-named bodies are necessarily washed away; but the tissue should be carefully separated with the scissars where it is thin and delicate, placed upon the glass without fluid, and adjusted with as little rending and disturbance as possible upon the slide; then covered with the thin glass, and a little dilute acetic acid be allowed to pass under the cover. In this way all the cells will be preserved, and the observer will be struck by their number and beauty. They are more plentiful in the yellow element; hence, in the subserous and subsynovial tissues, where this form of fibre is most abundant.

We will now return to our subject—a wound—and see how the cells of these tissues comport themselves under those circumstances. Mr. Bowman[*] has shown that when the cornea is wounded, there takes place in the edges of the wound, after a few days, a great activity of cell growth; the texture is filled with cells to such an extent as to render the structure at that spot opaque and milky in color; the cells fill up the wound, and after a time vanish, the disappearance commencing at the

[*] On the parts concerned in Operations on the Eye.

outer rim of the opaque part, and gradually contracting towards its centre, until the whole is again transparent; the wound, in fact, is united by a material identical with that injured.

Mr. Redfern* made numerous experiments upon dogs by passing a seton through a costal cartilage; the result was invariably great growth of cells inside the cartilage corpuscles, which were increased in size by this action, and which at last burst, discharging the cells free into the hyaline substance.

When a tendon breaks, or is divided in any animal, it will be found after a few days to be surrounded with a soft reddish matter, which also is spread among the fibres. Examined by the microscope, this matter will be found to consist of cells nuclei and granules. It extends for about half-an-inch from the wound, but decreases in amount as it recedes from its edges. A section of the tendon, just beyond this soft growth, shows the fusiform cells as having assumed a rounded shape, being very much larger, multinucleated, and granular.

When a bone is sawn through, as in amputation, or when it is broken, the truncated end, or ends, of the injured tissue throw out a material called granulation; this is formed of precisely similar constituents to the material thrown out around injured cornea or tendon—viz., cells nuclei and granules.

Again, areolar tissue, when injured and irritated, granulates, as we know, in a precisely similar manner. All these textures, under favourable circumstances, complete repair of the injury, by converting the mass of cells into the same material which received the hurt. The exception is cartilage, and even this unites by a similar, although not identical material; a sort of fibro cartilage.

This power of granulation is confined to connective tissue, and is due to the cells, which are disseminated through its structure. It is true that a wound in any part, and in any organ of the body, will granulate. Mr. Paget has given an account of the glazing of the surface of open wounds:—

" Blood gradually ceasing to flow from the surface of such a wound, one may still see some blood-tinged serous-looking fluid oozing from the surface; as this becomes paler, some of it collects like a whitish film or glazing on the surface, and this if it be examined by the microscope will be found to contain an abundance of the white corpuscles of the blood embedded apparently in a fibrous film. The collection of these corpuscles on the surface, especially on wounded muscles and fasciae, appears to depend only on their peculiar adhesiveness. One sees them adhering much more closely, than ever the red corpuscles do to the

* On the Abnormal Nutrition of Articular Cartilage.

walls of the minute blood vessels, and to the glass on which they are examined, and so on cut surfaces, while the other constituents of the blood flow away, the white corpuscles, and probably also some of the fibrine quickly co-agulating, adhere.*

These cells which Mr. Paget describes as white blood cells, are, I believe, derived from the areolar cells. It is difficult to understand how the white blood cells should, by their simple adhesive quality, be able to separate themselves sufficiently to form a glaze; nor how, when the fibrine "quickly coagulates," the red blood corpuscles should escape, and, on the other hand, the *locale* where this glaze principally appears are the fasciæ and the muscles, the former made of connective, the latter plentifully permeated by areolar tissue.† Besides muscles, a more delicate special-tissue, the brain, also granulates when wounded, and so plentifully, that the production sprouts out between any opening of the bone, and has been named *fungus cerebri,* and that this fungus, as well as the granulation from muscles, comes from the areolar tissue, may be strongly inferred from, if not altogether proved by, the following facts.

Firstly, we may cut off the fungoid granulations without producing bad symptoms nor loss of power, and without finding any cerebral or muscular matter in the excised portion.

Secondly, every cell in the body must have a progenitor.

If we entertain the idea of spontaneous production of cells, we must admit the spontaneous production of animals; a doctrine which cannot be held logically, and whose supposed facts are daily being proved fallacious—if the muscle or the brain cell were capable of producing the cells of granulation, those cells would, like their progenitors, be muscular or cerebral, or would, at least, be converted into muscle or brain, but none of the special tissues unite by similar structures.

Thirdly, wounds of the special tissues unite after granulation by a connective tissue, *i.e.*, the granulation cells arising from a connective tissue, produce a structure similar to that, from which they take origin.

The study of those morbid actions, which take place in certain joint diseases, first led me vaguely to consider in my mind some of the analogies and differences above stated, and to look more widely for similar processes, than merely into the

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* Lectures on Surgical Pathology, Vol I., page 201.

† It must be remembered that areolar tissue is of all structures the most widely spread throughout the body. It ramifies among and supports the minute fibres of the brain; it forms a constituent part of the heart, lung, and of all glands; it binds together the fibrellæ of the muscles.

actions of those parts, whose diseases I have been for some years more especially engaged in studying. The enormous growth of a soft gelatinous tissue in the so-called strumous synovitis perplexed me, for struma does not seem to predispose to the growth of any special tissue, unless we confer such a name upon tubercle; nor could there be perceived in this growth any peculiarity of material, which should render it more particularly fit to be classed among strumous complaints, although it is empirically evident that the so-called "Morbid Change of Stricture Degeneration of Synovial Membrane,"* is nearly or entirely limited to persons of scrofulous habit. While I was thus doubting a man was brought into Charing Cross Hospital, who had received a compound fracture at the lower end of the femur by a fall from a scaffold. Mr. Canton, under whose care the patient came, succeeded in checking the profuse hemorrhage from a a wound above, and to the inner side of the knee. Synovia afterwards flowed from the wound; secondary hemorrhage occurred however so frequently and profusely that it was found necessary to amputate the limb, nine days after the accident; I was kindly permitted to examine the part. It is unnecessary to relate here more than the state of the joint: all the inner and back part was so infiltrated by blood, that little could be seen, but that the parts were somewhat thickened. A wound of the synovial membrane on the inner side, admitted blood into the joint. The free surface of the synovial membrane was generally covered by clots, which had in great part, lost their colour; on lifting these away, the surface was found roughened by papilla-like eminences, and much reddened, and on the outer side of the joint it was seen, that the subsynovial tissue was changed into a gelatinous mass partly fibrinated. As this seemed to lead to the debated point, every part of the tissues, from the skin to the synovial membrane, was submitted to careful microscopic examination. I found, that for a certain distance from the synovial membrane, the whole areolar tissue was filled by or converted into a mass of cells, while farther outwards, the tissues were less full; and the fibres more distinct; still, passing outwards, the cells decreased in quantity until the membrane became normal.

The papilla-like growths were of precisely similar formation, in those parts where the growth was firmest, i.e., close to the synovial membrane, very many of the cells were fusiform and arranged, end to end forming lines three or four cells broad,

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* Sir B. Brodie conferred this title on the malady in question. "Diseases of the Joints," p. 72, 3rd edition.

and many of the cells in these rows seemed passing into fibre cells. The lines ran in many directions, intersecting each other, again and again, so as to enclose spaces, which were filled by round, and some fusiform cells, also by some bare nuclei, and a great number of granules. In other parts, which were further from the synovial membrane, the cells smaller in number were all, or nearly all round. Rokitansky has given some account of the process of growth of cells, from serous membranes under the name of " Gewebs-Vegetation," or vegetation of tissue ; but he appears to limit his description to the free surface of such membranes.

Now it is certain, that the synovial tissue belongs to the connective class ; for we know, that bursœ secreting a perfectly pure synovia, are formed out of areolar tissue wherever unusual friction occurs; and it is also certain that the gelatinous structure above described is simply formed by granulation. It is exactly similar in structure to the gelatinous or pulpy tissue of strumous synovitis; the difference consists only in the degree of development to which it will attain. The strumous habit predisposing to chronic inflammations is also marked by the low development of their products, and in such cases we find a growth of granulation—tissue, which does not advance beyond that stage. The same process takes place both in the joint cavity, and in the periarticular tissues. The whole of the textures surrounding the joint, and in part forming it, become a jelly-like mass, in which the synovial basement membrane, and the fibrous areolar tissue are lost, the ligaments also become softened by a like process, partly due to the admixture in their substance of common areolar tissue, and partly to the action of their own cells, so that in a little time the joint is loosened, the bones being no longer held in close contact. The state of the parts thus granulated is similar to that of an ulcer occurring in a debilitated constitution, where large, florid, flabby granulations crop out from the opening, and retard, by their want of further development the healing process ; if the condition of system can be improved, however, the granulations contract, organize, and the wound heals; so also in this form of joint disease, improvement in the general condition will lead to solidification of the granulation tissue.

The papilla-like growth from the free surface, to which Rokitansky has applied the name of tissue-vegetation, and which occurs in all serous inflammations assumes different forms in different cases. In chronic strumous synovitis, they commence as short broad-based cones, whose bases unite more and more until the conical shape is lost, and they appear as a mere

irregular wavy lining-tissue. As the inflammatory process is always more developed at the loose folds of the membrane; so this tissue is most abundant on those parts, therefore on the synovial fringes, and they thus come in a marked manner to overlap the cartilage; and to such overlying portions Mr. Key attributed the absorption or ulceration of cartilage.[*] In a paper, which appears in the *Edinburgh Monthly Journal* for February, 1860, I have endeavoured to show the real relationship of these growths to cartilaginous disease. Many parts of the cartilage will be seen, when this membrane is pushed back, to be of a dead white hue, to many parts the false membrane will be adherent, but certain spots of the articular cartilage, (not covered, not even accessible, until a late stage of the disease, to the granulation tissue), will also be found to have lost their lustre, even to be actually fibrous, while other spots, covered by the false membrane, will be normal. If from the spots which have lost their lustre, thin sections be taken and put under the microscope, it will be seen, that the cells for some distance from the surface have assumed a very great amount of growth, so that each corpuscle is much increased in size, and contains a large number of cells and granules; the hyaline structure has become fibrous, and ultimately the corpuscles burst, giving exit to the cells which are distributed freely among and in the fibres; some of these released cells now become fusiform, even stellate, and thus the structure, instead of remaining of the normal type of articular cartilage, assumes more the form of fibro-cartilage, and ultimately in far advanced and chronic cases of a sort of areolar tissue. In acute inflamations the same growth of cells takes place, but so rapidly as to absorb, or eat up, the hyaline structure, instead of previously, or merely converting it into fibres. This latter process leaves an ulcer with cleanly cut edges, such as Sir B. Brodie describes as "looking as though they were cut out with a chisel." The slower form converts the cartilage as above stated into a fibrous substance, and as the growth of new cellulo-fibrous membrane, from the continual action of the cells goes on, the new formed structure unites with the granulation from the synovial membrane by intermixture of the parts, *i.e.*, by growth of the cell struc-ture into each other, and it is this condition, which was sup-posed by Mr. Key to indicate that the cartilage was absorbed by a false tissue growing from the synovial membrane. The condition, however, of the cells of the cartilage at a dis-

* Med. Chi. Transactions, vol. xix.

tance from the surface, wherewith this false tissue may come in contact, negatives this idea; as well as the fact that precisely similar changes take place in spots removed from the influence of such tissue. It is not possible, moreover, to conceive, how the mere contact of a new formation with the surface of any structure should cause changes in the deep parts thereof.

The truth is, that the cartilage-cell undergoes the same process as those of any other connective tissue; of the areolar for instance, where we have already seen that granulation consists in great generative activity of the cells, whereby multitudes take the place of one or two, and convert the tissue into a cell-mass, which under favourable circumstances assumes further development into a fibro-cellular tissue.

When this action has gone on for some time, and generally before the granulation process shall have reached the attached surface of the cartilage; there begins in the bone an action whereby the articular lamella becomes detached, and the spongey end, with its cancelli, is laid open towards the joint. The walls enclosing the cancelli disappear more and more, by a process known as *caries insensibilis*. The disease is in fact caries occuring in spongey bone, and may be more or less rapid in its action; but it is otherwise the same, whether it be primary and independent of any other local disease, or whether it be secondary and following, as in the case we have been considering a synovitis. Two actions usually occur in this disease, one the absorption or disappearance of bone in the centre of inflammation, the other a deposition of osseous matter in the surrounding parts,* so as to cut off the carious portion from the rest of the bone. The first appearance of the malady is a coloration of the end of the bone in red, or rather pink, at one spot, if it be a large spongey end, as that of the femur or tibia. The color depends in part upon hyperœmia, in part upon an effusion of pinkish serum into the cancelli. The hyperœmia at first confined to the lining membrane of the cancelli soon spreads to the Haversian vessels. Suppuration commences in the focus of the inflammation, imparting to the part a dirty-yellow hue, which conceals the underlying redness of the hyperœmia, while in the surrounding parts, deposition of bones and solidification of the cancelli takes place, or if the disease be situated near the external shell of the bone, the thickening is produced by accumulation of bony matter beneath the periosteum in the form often of osteophytes. The disease thus described is *caries centralis*. Another form, *caries super-*

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* In much debilitated constitutions, this latter action may be absent, the case is then called diffuse caries.

ficialis begins beneath the periosteum, and then deposition of new bone takes place inside, instead of outside, the bony case, while suppuration and loss of bone matter occurs on the surface. If, in this condition, the thickened periosteum be stripped from the bone, it will be seen that instead of coming away with difficulty, and drawing from the smooth bone surface a few fine fibres, it will, on leaving the bone, drag with it a number of thick soft ridges and plugs, which come easily out of corresponding grooves and holes in the bone. The osseous surface itself, when cleaned of pus and other effusion, is seen roughened and perforated like a worm-eaten piece of wood. Very little examination of a surface-section of such bone, shows that each of these large holes and grooves is produced by the melting away of a whole Haversian system, which opened on the surface perpendicularly or longitudinally. The mode in which the system melts, may be thus described : the bone cells surrounding an Haversian canal increase in size, their interior looks very granular, their canaliculi grow both in size and number; thus the bone tissue loses in substance, but besides this it becomes coarsely granular, in parts actually studded with little holes. By and by the Haversian canal itself increases in size, while the thickness of the system decreases; this takes place by opening of the first circlet of cells into the canal, partly through increase in size, partly through disappearance of the bony partitions. Such process goes on from one circle of bone cells to the other, until the whole system has dissolved into a soft, granular, and cellular mass, which, if it be on the surface, comes out like a plug with the periosteum. In my possession is a section from a carious phalanx showing this process in different stages, the first being simply enlargement of the cells, the last a condition wherein the whole Haversian system is rendered black and opaque by the enormous development of the cells and the softening of the bone structure. Another preparation taken from a spongey bone in a carious state, shows the gradual destruction of the walls of the cancelli by a like growth of the cells. The process is very similar, indeed, nearly identical, with the inflammatory ulceration of cartilage, consisting in a growth of cells so abundant as to absorb or change the intecellular parts, converting them into a granular, nuclear, and cellular mass, more or less mixed with cell-fibres.

Thus a chronic inflammation of connective tissues, chiefly consists in abundant generation of new cells from the old ones, which form an essential part of the tissue ; the deposition from the blood of coagulable lymph, which gradually solidifies

and becomes organized, is a rare effect of a chronic inflamma-
tion,* the thickening, which is so often its result, being due to
a cell-growth, and to the formation of new tissue, thereby pro-
duced. The joints, which by their very nature consist of a
variety of connective tissues, are very liable to inflammations
of the chronic sort, and to abundant cell-growth in those tex-
tures.   This action is a *vis medicatrix naturæ* of a very marked
kind, for when the inflammation has proceeded far enough to
render the joint useless, it converts the synovial membrane, the
cartilage, and failing that, the bone itself, into a granulation
tissue, whose nature being to unite and to contract, tends to
obliterate the cavity, and join the bones.   This granulating
action usually begins like the inflammation in one of the tex-
tures only, but gradually spreads to the others, so that in the
end they all become affected in the same way : whether the
disease may have commenced in one part or another, the ten-
dency always is to surround the joint cavity with granulation-
tissue, which by its further organization and growth, shall fill up
that space.   Certain circumstances, however, retard or prevent
the fulfilment of this process.   One is want of further develop-
ment, the other degeneration.   The former gives rise to those
slow, intractable cases of chronic strumous synovitis, or pulpy
degeneration of synovial membrane.   The latter has, up to a
certain time, the same history ; following the inflammation and
growth of cells, there comes a time of inaction, which is super-
seded by fatty degeneration of large portions of the cell tissue,
accompanied by profuse suppurations and destruction of parts,
caries necrotica, &c.

By this pathology we are able to account for, and to follow
many of the different forms and vagaries of joint disease, which
under any other theory, are inexplicable.   We might enter
more widely into the subject and show how suppuration in deep
parts, with formation of abcess, how certain low forms of
ulceration, of bone disease, of contraction in fibrous structures
are produced by this generative quality of the cells of the con-
nective tissues, acting under different circumstances.   But the
limits of our space forbid a further discussion of the actions,
and enough has, it is hoped, been done to render the views on
articular disease more logical, and to lead to certain important
modifications in treatment, which reasonably may be deduced
from the pathology, and which practically are found beneficial.

* Limited probably to the rheumatic form, in which there is some reason to
believe such mode of tissue-formation may occur.

ON THE ANATOMY OF THE LIVER IN HEALTH AND DISEASE.

By Lionel S. Beale, M.B., F.R.S.

IX.

FATTY LIVER.

DEPOSIT OF THE FATTY MATTER IN THE CENTRE OF THE LOBULES.

IN the specimens of fatty liver which I have hitherto examined, the fatty matter was deposited principally at the margin or *portal aspect* of the lobules. In the present instance, however, the cells near the postal surface of the lobules are comparatively free from fat, while this substance is present in large quantity near the intratobular or hepatic vein. The deposition of fat seems to have commenced in the centre, and to have spread from thence towards the circumference of the lobule. In the fatty liver of phthisis, and in other varieties of fatty liver, which have been described by authors, the oil globules are very numerous towards the circumference of the lobules, while often none can be detected in the centre. The accumulation of fatty matter at the outer part of the lobule is often so great as to map out the lobules most distinctly, the central part of each being surrounded by a broad belt of fatty matter which looks quite white by reflected light.

In the present instance the deposit of fatty matter took place differently, and must have been due to causes of a very different nature to those which determine this change in the liver generally.

The liver was obtained from a girl, aged 14, who was found in a field in a state of starvation. No history could be obtained, and her intellect was so much impaired that she was unable to give any account of herself. She had probably endured cold and exposure, and had received but a very small allowance of food for a considerable period of time. She was admitted into the hospital in a state of extreme emaciation, and was placed under the care of Dr. Todd. She lay in a dull listless state, but never rallied, and died five or six weeks after her admission. No morbid condition of any organ could be discovered by the unaided eye. There was generally extreme emaciation, and an almost total absence of adipose tissue. The liver was the only organ I examined microscopically. It presented nothing remar-

kable on general inspection, and its size, colour, and consistence, were normal. It contained little blood.

Now, in this case, it is clear, that the presence of the fatty matter cannot be attributed to the existence of a large quantity of fat in the portal blood. It can therefore hardly be referred to increased nutrition of the cells. It is very improbable that in such a case the cells should have possessed an increased power of attracting fatty matter from the blood. It would seem as if the nutritive processes were almost entirely suspended, and although life was prolonged for a considerable period, the waste seems to have continued in spite of every attempt to introduce a sufficient quantity of nutrient materials into the organism. Why did not the cells at the circumference of the lobules which are the oldest, undergo a morbid change before those in the centre? The most important changes occurring in the healthy organ undoubtedly takes place in these cells. The portal blood, rich in fatty matters and other constituents, recently absorbed from the intestine reaches these cells first, and before it arrives at the centre of the lobule, certain substances entering into the formation of bile, are doubtless almost entirely removed. Here the circulation is slowest, and in this part of the lobule the most active secretion of bile undoubtedly occurs. It is in this situation that the changes in fatty liver, and those in cirrhosis of the liver undoubtedly commence. It must be borne in mind that the cells grow from the centre towards the circumference of the lobule, the youngest cells being always found in the former, the oldest—in the latter situation. The *development* and multiplication of the cells then appear to take place near the hepatic vein, where the circulation is most rapid, their *growth,* as they pass towards the circumference of the lobule where the blood is distributed over a great extent of surface, and the circulation comparatively slow.

The accumulation of fatty matter in the present case would seem to be due to changes affecting the development and early growth, rather than upon those connected with the secreting action of the cells. It is difficult to explain the manner in which the fatty matter is produced, but it is not unreasonable to suppose that the material so closely resembling oily matter in its microscopical characters which seems so intimately connected with the formation of nuclei, should accumulate to an unusual extent in a case where the conditions necessary to the complete development of the nucleus, and the material which surrounds it, are not present. There would seem to be a greatly increased proportion of fatty matter in this part of the lobule without any absolute increase, and possibly even with a dimu-

nition in the total amount of hepatic tissue entering into the formation of the lobule. Probably some constituents present in a normal state are entirely absent in this instance. The force to which their separation from the blood, and their conversion into the materials of the normal cell is due is wanting, and substances which ought to have been converted into the material of which the cells are composed and from which the bile is formed, remain in a crude state and assume the form of fat globules as has been described. At the same time it must be admitted that this explanation is not very complete or satisfactory, and it is offered only in the hope that more light may be thrown upon the subject in future investigation.

In Fig. 1, Plate II, the general appearance of a thin section of the liver in which the portal vein had been injected, is shown —a portion of a lobule more highly magnified in which the branches of the hepatic vein were injected is figured immediately below this (Fig. 3). The large oil globules in the centre of the lobule are well shown, and their gradual diminution towards the circumference, where the tubes appear to be filled with brown granular matter, is represented. Below this figure some of the collections of oil globules are seen. In Fig. 7, the branching of the duct and its connection with the tubular network is very distinct.

In these drawings there is little indication of the existence of true cells, indeed it is very difficult in many diseased specimens to detect any thing like a liver cell as it is usually described. The free portions observed are certainly not enclosed in a cell membrane, but appear to be fragments irregularly broken off from the mass which occupies the tubular network. Many portions were observed closely resembling those figured in which there was not the least cellular appearance. I have already alluded to this subject in the "Anatomy of the Liver," page 47, and I propose to discuss this important question in its numerous bearings in a future communication.

The conclusions derived from an examination of this liver may be summed up as follows.

1. The fatty matter exists in the central part of the lobules, and diminishes in quantity towards the circumference.

2. The changes probably are connected with the development and early growth of the cells, not with their secreting action.

3. The nuclei of the cells are destroyed and degenerate, or are not formed at all in that part of the lobule where their multiplication takes place in health, and oily materials which would have been altered during the development and multiplication of nuclei remain in a crude and unaltered state.

RESULTS OF THE CHEMICAL AND MICROSCOPICAL EXAMINATION OF SOLID ORGANS AND SECRETIONS.

EXAMINATION OF SPUTUM FROM A CASE OF CANCER OF THE PHARYNX AND ADJACENT PARTS.

FOR the interesting specimens of cancer figured in Plate III, I am indebted to the kindness of my friend, Mr. Newham, of Bury St. Edmonds. They were present in sputum expectorated by a woman, aged 44. Mr. Newham sends me the following history of the case :—

CASE.—The patient was a small spare woman, with small features and very pale. She had never been married, and had for some years been a cook in London. Her health for some years past had been indifferent, but being of an active disposition she had never been obliged to discontinue her employment.

About thirteen weeks ago she was seized with great pain, apparently situated about the centre of the base of the skull, extending to both temples and over the head generally. She was never free from it, and often it increased in severity. There was a dry cough. In a few weeks the throat became sore, and the effort of swallowing produced pain, but nothing could be seen upon carefully examining the mouth and throat. The pain in the head gradually increased, and deglutition became still more troublesome. The pain in the head was so much increased by sleep that she feared its approach, and refused to take anodynes. At length sputum made its appearance. The cough always appeared convulsive in character, and was accompanied with nausea and a desire to clear the throat of discharge, and did not seem to result from pulmonary obstruction. The sputum was not in the least offensive until a day or two before death. Gradually, in addition to the pain of swallowing, that is, of the *muscular effort* necessary to the act, there arose a difficulty of getting the food beyond a certain spot opposite to the thyroid, but no swelling could be detected by external examination in this region. At length the cervical glands began to enlarge ; the pain and difficulty of swallowing from obstruction of the œsophagus increased. The sputum became more abundant, and her strength failed. She died from exhaustion consequent upon the small quantity of nutriment she was able to take. For the last three weeks of her life she refused all medical aid. As she became weaker the pain diminished, and almost subsided a few days before death.

Mr. Newham thus describes the post-mortem appearances : —" The cervical glands involved were situated just outside the carotid sheath. A portion sent for examination was removed from the under surface of the sphenoid and occipital bones; in fact, from the roof of the pharynx. The bones were carious,

but whether so originally or from the ravages of the disintegrating deposit did not appear. It felt pulpy, fibrous, and somewhat gritty. The thyroid was considerably enlarged, and a portion of it, which was as hard as bone, was impacted between the larynx and œsophagus, and pressing so tightly on the latter for the last fortnight as to render deglutition almost impossible.*

Microscopical examination of the sputum.—A portion of the sputum was placed upon a slide and covered with thin glass, and examined without the addition of water or any chemical reagent. The appearances observed are carefully delineated in Plate III. The drawings were made upon the wood block, and were accurately copied from the specimens in the microscope. I am indebted to Mr. Wragg for the beautiful and very perfect manner in which the engraving has been carried out. It is only justice to the engraver to say that so perfect a representation of microscopical appearances on wood has very seldom been obtained.

The specimen is a very instructive one, and shows the manner in which the cancerous mass grows. On a cursory examination it would appear that the drawings confirm the statements of many observers with regard to the so-called endogenous multiplication of cancer cells, and excellent examples of the so-called parent cells seem to be scattered abundantly all over the field, but a careful study of the subject proves that the different bodies alluded to are not cells at all. Only a few of the general forms which these bodies assumed are represented, but there were other intermediate shapes too numerous for representation. The observations upon the character of these bodies will equally apply to a number of cancerous growths, but as the appearances in this case were so unusually distinct and well defined, and as it was quite impossible they could have been produced by artificial means, I have selected them for careful study.

Now it will be observed that the bodies in question are not all composed of the same material. Some refract light differently to others, as indicated by the different varieties of shading, and there is an absence of that granular appearance which is observed in the greater number of specimens figured. The cellular appearance of many of the bodies in question is fallacious, and many that would be termed mother cells are only

* "I only had permission to examine the throat, but I ventured as far as the chest, and as far as my observations extended, I found no other morbid products or appearances than those I have mentioned. Lungs quite healthy."—Extract from Mr. Newham's letter.

masses of granular matrix with nuclei irregularly scattered through them. In some instances these have broken in such a way as to leave cavities into which the nuclei evidently fitted. At p, fig. 1, such a mass is seen, and at the lower portion is a cell-like piece nearly detached, with others which are quite separated. It is difficult to explain all the appearances represented in the figure, and for the present I shall content myself with illustrating the principal forms exactly as they appeared in the microscope. They were not treated with any reagent. Water was not even added, so that the appearances represented are not produced by any artificial processes whatever. A portion of the mass removed after death is represented in fig. 2, and in fig. 3 the microscopical characters of one of the cervical glands are indicated.—[L. S. B.]

URINE SUSPECTED TO BE CHYLOUS.

By Dr. Milner Barry, Tunbridge Wells.

THE present case of chylous urine differs in some respects from that described in page 11 of the first volume of the Archives. For the specimens of urine, and for the following notes of the Case, I am indebted to Dr. Milner Barry of Tunbridge Wells, who has taken great trouble to discover the real nature of the affection.

Case.—William Avery, aged 10, a staid-looking pale complexioned boy, but fairly grown and nourished for his age, has always been delicate, his spirits outrunning his strength, but does not appear to have suffered from any serious attack of illness, until last summer, when hœmatemesis and discharge of blood from the bowels came on, after a school feast, where he had displayed too much prowess as a trencher-man. This illness passed off without, apparently, leaving any ill effects. Three weeks ago he began to suffer from constant weakness and vomiting. Soon after swallowing his food, he has to rise up from the table, and the food was immediately ejected from the stomach. He also vomits "watery phlegm" when he gets up in the morning. There is some tenderness at the epigastrium, but not to any great amount, and no pain complained of in any region. Coincident with the commencement of this attack of

illness, he has been passing "milky urine," having never done so previously. It resembles milk more or less diluted with water, does not vary much from day to day or from night to day, seems to have no urinous smell, is acid, and usually about of the sp. gr. of 1018. After reposing for some hours, a cream-like layer forms on the surface, which becomes diffused again by agitation. By the application of heat or nitric acid, a scanty, curdy precipitate is produced. Shaken up with æther it becomes transparent, and a thin coagulum forms by repose between the ether and the urine.

This urine contained numerous oil globules, like those present in milk, and a substance possessing the ordinary re-actions of caseine, and it appeared, therefore, very important to avoid all possible chance of being misled by imposition. Dr. Milner Barry has been at very great pains to settle the question, but has not yet succeeded in satisfying himself beyond a doubt that the case is a genuine one of chylous urine. He has not actually seen the boy passing the urine, but has obtained the following statement from the boy's mother :—

" She positively states that she has repeatedly observed the boy passing the white urine. Several weeks before he had medical advice, she noticed that the water was white in the chamber-vessel of the little bedroom where he slept by himself. That she had seen the water white when he had made water in the courtyard behind the house. The white water and the dread-ful sickness frightened her very much. When he sat down at meals they always had a basin at hand, but the sickness used to come on so suddenly that the contents of the stomach were ejected before there was time to lay hold of the basin. For the last few months the sickness has left him, and the urine has not been white, but he does not look well. She had seen him herself passing the urine."

Dr. Barry goes on to say that, " This is the substance of the boy's mother's replies and statements. If there is deception, it seems to belong to the boy, and to be motiveless. There is one point, perhaps, worth noticing, viz. : that in cottages of the labouring population in towns, milk is not very extensively con-sumed, and therefore it would not always be at hand to enable this boy to play the imposter. I asked to have some of the urine sent to me if it should ever become white again."

If this was a genuine case of chylous urine, it would afford much interest as the fatty matter was in the form of globules, and not merely in a granular state. I have never seen a speci-men of chylous urine in which the fat occurred in the state of

globules like those of milk, but think it not improbable that such cases occasionally occur. The present instance cannot be regarded as conclusive, and Dr. Barry hopes that before long he may be in a position to determine the nature of the case with certainty.— [Ed.]

URINE OF CHOREA.

THE following specimens of urine were passed by a little girl nine years of age, who was suffering from chorea. The case was not a severe one, and, at the time the urine was obtained, had lasted about a month. The child was thin and weighed 44 lbs.

October 8th.— The urine passed in 24 hours amounted to 19 ounces = 8312·5 grains.

Specific gravity, 1018. *Reaction* acid.

Analysis.				In 24 hours.	In 100 of solids.
Water ..	..	..	958·70		
Solid matter	..	..	41·30	343	
Urea	..	..	24·00	200	58·11
Sulphates	..	..	2·096	17	5·07
Fixed salts..		..	12·008	100	29·07

October 9th.—The urine passed in 24 hours amounted to 24 ounces = 10500·0 grains.

Specific gravity, 1014. *Reaction* acid.

Analysis.				In 24 honrs.	In 100 of solids.
Water..	..	..	964·00		
Solid matter	..	..	35·80	376	
Urea	..	..	21·00	220	58·65
Sulphates	..	..	1·414	15	3·95
Fixed salts..		..	11·014	116	30·76

The proportion of urea excreted in chorea is very great, as has been shown in cases recorded by Dr. Bence Jones and others. A strong man, weighing about 170 lbs., passes not more than 400 to 500 grs. of urea in 24 hours, in a state of health. At the same time it must be borne in mind that, in health, the proportion excreted by children is much greater than in adults. Several analyses of the urine in cases of chorea are published in my lectures on urine, urinary deposits, and calculi.*

* British Medical Journal, 1859.

## DUMBBELL-LIKE CRYSTALS OF PHOSPHATE OF LIME.

FIG. 4 represents some of the largest crystals of this form which are met with. They were ac-companied by numerous crystals of triple phosphate and were deposited from the urine of a patient suffering from continued fever at about the fifth week. The case was under the care of Mr. Carver of Cambridge, to whom I am indebted for the specimen.—[Ed.]

FIG. 4.

Dumbbell crystals of phosphate of lime.

CIRCULAR SPORULES CLOSELY RESEMBLING BLOOD CORPUSCLES IN URINE.

THE deposit represented in fig. 5 was obtained from acid urine which contained a little oxalate of lime. The secretion was in other respects normal, and reference is only made to it here in consequence of the very close resemblance of many of these sporules, both in form and size, to red blood corpuscles. Upon careful examination, however, many bodies were observed with a point in the centre and larger than a blood corpuscle. If blood corpuscles were present in great numbers, albumen would of course be detected in the urine, and all doubt as to the nature of the circular bodies would thus be removed, but where only a few have escaped, this character would be absent. In doubtful cases, the urine must be kept for a few days when the germination of the sporules and their increase in number will place their true nature beyond a question. The circular crystals of oxalate of lime which are also very much like these bodies are not altered by remaining in the urine, and blood corpuscles can always be distinguished by the ragged edges which appear after maceration in urine, and by the difference of their refractive power.

FIG. 5.
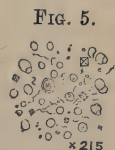
Circular sporules, resembling blood corpuscles, from acid urine.

SOFT CANCER OF THE TONSIL.

THE growth which is represented in fig. 6, was removed from the throat of a woman seventy-eight years of age, by Mr. Hooper of Aylesbury. Mr. McCormick sends the following particulars of the case. The patient's previous health had been good. Six weeks before her admission into the infirmary she experienced a soreness and smarting sensation, attended with a slight enlargement of the left tonsil. The

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tonsil has now (May 1859) attained the size of a pigeon's egg. The outline is irregular, and its upper and inner borders, which are free and excoriated, are covered with a yellowish secretion. It is attached by a few fibres to the mucous membrane lining the cheeks, and to the base of the tongue. To the touch it is moderately hard. No enlarged glands could be detected about the throat or neck. It was excised by Mr. Hooper, and very

FIG. 6.

× 215
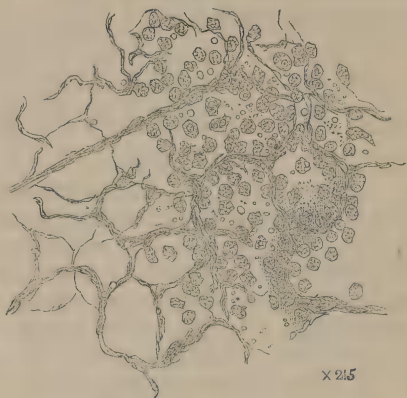
Tumor removed from the tonsil of a woman aged 78. The cells and delicate fibrous matrix sparing in quantity are represented. On the left the fibrous matrix is alone shown.

slight hæmorrhage followed the operation. The growth was transparent and well supplied with vessels. A section could be easily obtained by Valentin's knife. There was a small quantity of fibrous tissue forming the walls of areolæ which were filled with a clear transparent substance containing numerous cells. The patient is still alive.—[L.S.B.]

ACCUMULATED MENSTRUAL FLUID.—IMPERFORATE UTERUS WITH DEFECTIVE VAGINA.

MR. HOOPER, Aylesbury.

Case.*—Martha Smith, æt. 23 years, admitted into the Aylesbury Infirmary, May 2nd, 1859, under the care of Mr. Hooper. Light hair, fair and healthy complexion. With the exception of fever 3 years ago, her general health has been good. When she had attained her 17th year she states she observed a slight appearance of menstruation, but since then there has not been any recurrence of it, though at irregular intervals she has had pain in the lower part of her back and hips.

About 6 months prior to admission she observed that the left and lower part of her abdomen had become enlarged, the pains also, to which allusion has been made, were much aggravated and she occasionally experienced difficulty in micturition.

* Reported by Mr. McCormick, House Surgeon to the Aylesbury Infirmary.

The abdomen as high as the umbilicus is found enlarged and hard, the enlargement extending higher on the left side; it is not tender upon pressure.

Upon separating the vulva, a tumor is visible a short distance within its lips, it is elastic, adherent throughout its whole circumference, so that scarcely any trace of vagina is discernible, nor can any os uteri be detected.

Rotation of tumor in hypogastric region influences the tumor just within the vulva, clearly indicating its uterine character.

On May 8th a puncture was made into the elastic tumor with a trochar and a dark fluid of a chocolate color, inodorous, slightly coagulable, and of the consistence of treacle, amounting to 40 oz., was evacuated. Upon introducing the finger into the aperture, after the expulsion of that fluid, it passed directly into the dilated cavity of the uterus, the fundus of which could not be felt, its interior was smooth anteriorly, posteriorly corrugated, and it was evidently contracting.

The distance from the orifice to the fundus measured $6\frac{1}{2}$ inches.

After the operation no hypogastric tumor could be felt.

14th. There has been a considerable quantity of discharge since the operation, at first florid, subsequently assuming a pale color; the cavity of the uterus has become contracted into a narrow passage measuring $4\frac{1}{2}$ inches in length, and the aperture scarcely admits the point of the fingers.

Microscopical Examination.—The microscopical examination of this fluid afforded interesting results. It contained a vast number of the large compound cell-like bodies, which are so common in the blood of the spleen, called " blood corpuscle-holding cells." Such bodies are not unfrequently detected in blood which has remained for some time in contact with living tissues, as in cerebral hæmorrhage, extra-vasations of blood into cavities or into cysts, &c. The bodies in question are not in fact cells, but mere collections of blood corpuscles which assume more or less a spherical form. There is no cell wall on the exterior of the mass, but the viscid material which causes them to cohere fills up the intervals between them, and thus the outline of the mass appears smooth, and even an outline like that of a cell-wall is produced.

Fig. 7.

Retained menstrual secretion showing collections of blood globules and altered corpuscles.

In this specimen of retained menstrual fluid, were observed masses of every size and form. A few of these are represented

E 2

in the cut and amongst them were numerous altered and partially disintegrated blood discs and much dark brown granular matter consisting no doubt of altered coloring matter of the blood.

The chemical composition of the fluid is shown in the following analysis:

Analysis 34.

Water	..	..	..	..	792·00
Solid matter	..	..	..	..	208·00
Soluble in { Insoluble in alcohol..					3·18
water { Soluble in alcohol				..	3·78
Albumen and blood corpuscles				..	182·44
Fatty matter	..	..	..		2·80
Alkaline salts	..	..	..		6·24
Earthy salts	..	..	..		9·56

LEUCINE.

Fig. 8 represents the appearance of crystals of leucine, under a power of 130 diameters. Those marked *a*, were obtained by crystallization from water, the others from an alcoholic solution. The recognition of this substance, has of late years become very important. It is sometimes met with in the liver, and it has been detected in the urine in several cases. It sometimes exists in the pancreatic secretion, and has been found in other animal fluids. It may generally be recognized by its tendency to crystallize in spherules, and in acicular crystals, which are soluble in water and very readily soluble in alcohol.

Fig. 8.

Crystals of leucine. Those represented *a*, were crystallized from water. The rest from an alcoholic solution.

Glasgow Medical Journal.

Journal de la Physiologie de l'Homme et des Animaux, publié sous la direction du Docteur E. Brown-Sèquard.

American Medical Monthly.

North American Medico-Chirurgical Review.

Archiv für die Holländischen Beiträge zur Natur und Heilkunde.

Guy's Hospital Reports.

New York Journal of Medicine.

Journal of Practical Medicine and Surgery.   English Edition.

Quarterly Journal of Dental Science.

Ophthalmic Hospital Reports and Journal of the Royal London Ophthalmic Hospital.

Archiv für Pathologische Anatomie und Physiologie, und für Klinische Medecin.   R. Virchow.

*** The Editor will be happy to exchange with any other Journals.

BOOKS RECEIVED.

Jos. v. Lenhossek, Neue Untersuchungen über den feineren Bau des centralen Nervensystems des Menschen. 1. Medulla spinalis und deren bulbus Rhachiticus.

The author gives a minute description of the medulla oblongata.   His researches were carried out upon sections made in various directions, prepared by a modification of the process recommended by Mr. Lockhart Clarke.   The anatomy of the ganglion cells and of the fibres, is given.   The connections of the anterior and posterior roots of the spinal nerves, the system of nerve fibres distributed to the pia mater, and the anatomy of the hypoglossal spinal accessory, pneumogastric and glossophargugial are fully described.   The memoir is illustrated with five tinted lithographic plates.

Dr. Russell Reynolds.   The Facts and Laws of Life.   An Introductory Lecture delivered at the Westminster Hospital.

The author considers the "aim" of the student, and the subject matter of his study.   He urges the vast importance of learning facts, and discusses what is meant by *Law*, showing the importance of not confounding the laws of nature with statistical results.   He concludes, by urging the student to be generous in feeling towards others, and to work for the benefit of his fellow men.

Joseph Lister, F.R.C.S., and W. Turner, M.B.   Observations on the Structure of Nerve-Fibres.

In this paper, the authors show that the white substance of Schwann, is arranged so as to form concentric layers round the axis cylinder.   The specimens were prepared according to a plan recommended by Mr. Lockhart Clarke.

Portions of the spinal cord were soaked in dilute chromic acid, and thin sections of the hardened cord steeped in a solution of carmine in ammonia. The specimens were afterwards mounted in Canada balsam. The axis cylinder alone becomes coloured under these circumstances. Mr. Lister adds some supplementary observations on the fibrous arrangement in the white substance of schwann. The paper is illustrated with a chromo-lithograph.

The Australian Medical Journal, No. 16, October, 1859, Melbourne.

The number contains original papers, reports of societies, hospital reports, general correspondence, &c. The journal is published quarterly.

Dr. Halford. The Action and Sounds of the Heart. Churchill.

Dr. Halford considers that the first sound is produced by the tension of the auriculo-ventricular valves, and brings forward numerous facts and new experiments in support of this view.

The memoir is illustrated with several well-executed wood engravings, and contains numerous observations of great interest as well as practical importance.

Dr. Munroe, Medical Statistics of the Hull Police Force.

The report shows the amount of sickness in the Hull Police Force, during the last two years. The force consists of one chief constable, five inspectors, ten sergeants, and one hundred and six constables. The affections from which the greatest number have suffered in the last year, are, *cold*, 138 ; *diarrhœa*, 72 ; *dyspepsia*, 72 ; *fever*, 60 ; *rheumatism*, 22 ; *cough*, 17. There was one death from phthisis.

B. Wills Richardson, F.R.C.S. Pathological Researches, Part II. From the Dublin Quarterly Journal of Medical Science.

This memoir contains the following cases : Excision of a portion of the lower jaw ; rapid recurrence of the disease after operation. Case of fragments of a round shot in the right eye. Congenital opacity of the cornea, with adhesion of the iris. Intra-uterine periostitis. Illustrated with woodcuts.

Dr. Brinton on the Action of the Pancreatic Juice.

The author shows that the solution of albuminous substances by the pancreatic juice, is slow and imperfect, and is accompanied with putrefactive changes. The solvent power was much increased, after the infusion of pancreas had been kept for some time. Although the author agrees with Corvisart, in assigning to the pancreatic secretion out of the body, a power of dissolving albuminous substances, he considers that such an office is not performed in the living organism.

Dr. W. Roberts. A contribution to Urology, embracing observations on the diurnal variations in the acidity of the urine, chiefly in relation to food (Mem. Manchester Phil. Soc., 1859).

Dr. Roberts confirms the observations of Dr. Bence Jones, that the urine is rendered less acid, or even becomes alkaline, a short time after a meal. After some time, the acidity is increased. The depression of the acidity coincides with the *absorption* rather than with the *digestion* of a meal. The mineral constituents of a meal depress the acidity of the urine. The kidneys regulate the alkalinity of the blood.

CLINICAL OBSERVATIONS.

A CHAPTER IN CLINICAL MEDICINE. WHAT TO OBSERVE IN
DIPHTHERIA.

By W. OGLE, M.A., M.D., Cantab., Physician to the Derby Infirmary.

IT is generally acknowledged that clinical records are very
unsatisfactory. They are either too long or too short; too
diffuse or too curt; too particular or too indefinite; too opinion-
ative or not sufficiently attested; or, more commonly, they have
all these faults in combination. They are diffuse and opinion-
ative on some points, even egotistical, *usque ad nauseam*; and
therein they are too long and too particular; at the same time,
they are too general, or altogether silent on other matters, and
this makes them lifeless, and practically too short. These
defects are easily seen when the work is done; one's own note-
book is full of them; the difficulty is to avoid them *ab initio.*

Each fault may be traced more or less directly to a common
origin—the want of method. This paper therefore, is, in the
main, directed to the advocacy of *Method in Clinical Medicine.*
Diphtheria is chosen simply as an opportune illustration.

The first step towards the cure of a disease is to understand
its nature and essence; we care not so much for its name, as
for its nature; and its nature cannot be fully understood, with-
out searching into its cause or essence. In the same way, when
we wish to remedy any other evil, such as that which is before
us, we begin by making a plain statement of existing defects;
and, having done this, proceed at once to inquire into their
origin.

The faults that have been specified may be classified into
those of omission; those of repetition; and those of substitution
of opinion for fact, with their opposites. Each of the three

requires separate notice; their opposites, being less common, need only be mentioned by way of qualification; for it must not be deemed an excellence to exclude every expression of opinion, to condemn repetition under all circumstances, or be thought possible that a record can be made so perfect as to give *every* important particular.

In any case of sickness, there are so many things which might be recorded, that the omission of some of them is a necessity. But as we cannot tell, *à priori*, what to omit, the difficulty can only be dealt with indirectly; and the first thing which seems worthy of note is, that the inconvenience does not arise so much from the fact that certain characteristic features of a case are omitted, as that those which are recorded are presented in no definite order, and without reference to any plan.

The rule that is for the most part followed, if rule it can be called, is for each person to note the facts, which, at the time of observation, are most striking to himself. But the same facts are not always equally pronounced in any two cases of the same disease; nor in the same case on any two occasions; nay, further, in the same case, and at the same time, the same facts will not arrest the attention of even two, different persons, if they act independently of each other. Different people omit different things, because they do not agree to record the same things; and facts, which ought to be mentioned together—almost in the same breath, are dissociated, because they do not happen, at the time of observation, to be equally striking.

It is not till we attempt to compare our records, that the inconvenience of this is perceived; but then it is too late to supply deficiencies. Prevention is the only cure; a definite plan of observation is the obvious remedy. If a plan be used, be it ever so imperfect—let it comprehend but one half of the characteristic features of the case—yet those that are recorded will be the same in all. As the same plan has been used in all cases, analysis will be easy; and each record will contribute, either by way of confirmation or of correction, to the former store of knowledge. Thus a plan has a constant tendency to reduce the number of omissions, and, meanwhile, by ensuring uniformity, it lessens the evils which arise from those that exist.

The objection to a plan that it is too troublesome to use, is not to be ignored, nor, on the other hand, is it to have more weight than its due. It is in accordance with our experience in other matters that method, in the end, saves time, and, therefore, trouble also. It is pre-eminently so in the study of medicine. With a plan, the work of to-day will further and make more complete that of yesterday; without a plan, we do and

undo with the same hand : we know not whether of the two, the more. But as a present trouble, though a minor one, has always more weight than an advantage which is wholly prospective, the objection must be kept in mind, and all that we can hope for, is, that it be not pressed until the plan itself and the mode of using it have been explained.

The second fault, that of repetition, has been already dealt with to a certain extent ; this was unavoidable. Repetition is a fault very closely allied to that of omission, and the remedy is the same for both : it will however be useful to examine this fault by itself, and to trace it to its origin.

Under all circumstances, and especially in "case-taking," we should be careful always to finish one thing before we turn to another. It is obviously most difficult to avoid digressions, where every striking fact is a temptation to start aside. Unless we have some monitor continually at hand to warn us, we obey the impulse without a thought. Nothing is more common in a clinical record than to speak first of the pain (say in the head) ; then to start off to the condition of the tongue, pulse, etc. ; and then finding, perhaps, that the pain ought to have been more fully described, we return and mention it once more. It may be, that now we discover that sickness often accompanies the pain ; and this takes us back to the state of the stomach, and thence to the bowels, till we meet with some other fact that sends us once more to the nervous system. The result is, that a confused and ill-defined picture is left upon the mind, which is, to say the least of it, very unsatisfactory.

The remedy for this needless repetition is the same as that for omissions ; we must have a plan of observation ; all facts that are of similar import will then be grouped together, and that which is mentioned once, will be mentioned once for all. The plan must be such an one as will serve for general use ; every other that special circumstances may require, must be based upon the general one. The determination, "*what* to observe" must be left, to a certain extent, an open question ; otherwise we should be at fault in the investigation of every new disease, *i.e.*, under the circumstances which, of all others, most require us to proceed in a systematic manner.

But besides the natural grouping of the symptoms, there is a proper order to be observed. Thus, the condition of the tongue, of the stomach, and of the bowels, are facts, which not only naturally come together, but they arrange themselves in the order suggested by the anatomical relation of the parts. Similarly, in examining the chest of a patient, it is natural for

the observer to state first the symptoms which first present themselves, and afterwards those which are elicited upon a more close investigation. The shape of the chest; comparative expansion of the walls; condition of the muscles of respiration; are phenomena which present themselves to the mind, before those which are obtained by means of percussion and auscultation : still further, in listening, the sounds during inspiration come before those of expiration ; and both, before the sounds of resonance ; and of these again, cardiac resonance before vocal resonance ; this, therefore, is the order which should be observed. Both the order and the association of symptoms are determined by simple considerations, which commend themselves at once, as being in accordance with nature. By taking advantage of these, one great objection to a plan—that it is burdensome to the memory—is removed. On the contrary, it is an assistance to it ; whereas if the natural order is interchanged or reversed, the probability is, that some particulars will be forgotten ; or, at least, an idea of incompleteness is left upon the mind.

The third fault, that of stating a conclusion, when a fact might be given instead, requires something more than the use of a plan for its removal; though it is less likely to occur with a plan than without one.

A case may be related with considerable fulness, and with all possible regularity and order, yet it may both be unsatisfactory as it stands by itself, and useless for comparison with other histories of the same disease ; and all, because the observer has given the conclusion he has come to, instead of the facts on which his conclusions rest. Though the use of a plan will not of necessity remove this evil, it will have a tendency to do so ; both by the way in which it will itself require facts and not opinions to be stated, and because the very act of using it implies consideration ; the want of which is the principal cause of the defect.

It requires consideration to perceive that conclusions are not so serviceable as facts. Thus it is very common, and at the time seems to be of little importance, whether we say " pulse quick," or " very quick," instead of " pulse 100," or " 140," as the case may be. But a moment's thought, and the wish to compare the action of the heart with that of the lungs, or the pulse of yesterday, with that of to-day, or of any other day, are sufficient to show that the opinion, " quick " and " very quick " is of comparatively little value ; whereas the simple statement of the number of beats per minute is all that is wanted.

It may sometimes be more easy to draw an inference, than

to state clearly the grounds on which it is based; but when the value of facts is fully apprehended, the extra trouble that they demand, will not be thought worth mentioning.

Besides this, there are so many things that cannot be given otherwise than as conclusions, that facts are the more valuable, being necessary to give a substance to the history. Of the pulse, the number of beats per minute, and the regularity of the impulse, are facts which we can ill afford to spare, when so many other characters, its being "full," "compressible," "thready," "bounding," &c., can only be given as matters of opinion.

Nevertheless, there are certain general conclusions which, when expressed in a natural manner, impart life and reality to the scene. Such are those which tell of the hopes and fears of the medical attendant, or the reasons for pursuing a particular line of treatment; but it is necessary that they be introduced naturally; they must be given with all the freshness which they have at the time that they occur to him, and not foisted in as after-thoughts, than which nothing tends so much to shake the confidence in the truthfulness of the narrative.

This faculty of giving life to the subject without being egotistical, is most difficult of attainment. It is probably very near akin to, if not the natural fruit of, that largeness of heart, which is combined with humility and singleness of aim, and which marks the true philosopher. It is, therefore, worth cultivating for its own sake, though it claims attention in this place on account of its practical value in a clinical record.

Bretonneau's cases are quite a study in this respect; the reader is carried on with the writer by an impulse almost irresistible; his interest is excited, and, as a natural consequence, the facts make a much more lasting impression than would otherwise be possible.

It will occur to many, that a plan is likely very much to check the expressions of opinions such as these; it is continually urged against plans in general, that the use of any conventional method in drawing up clinical records makes them very stiff and destitute of that natural ease which is found in a picture drawn from life. Much, however, will depend upon the kind of plan that is adopted; if it is true to nature, the fault will not be justly chargeable to the plan. Fortunately a certain degree of stiffness, and that to an extent which would be quite inadmissible in ordinary narrative, is, in clinical medicine, nothing more than terseness and vigour; and it is to be wished for, rather than not. To hit the proper mean may be difficult; but few will question, that stiffness and awkwardness of style

is a less fault, than that loose, indefinite, prosing which is so
much more likely to occur.

Thus each fault has been traced, more or less directly, to the
want of system in making our observations. I have shown,
that conclusions are given instead of facts, from want of con-
sideration, and that the use of a plan will ensure the considera-
tion that is needful ; that the absence of order, and the needless
repetitions, are but the natural consequences of proceeding
without a plan; and that, whilst omissions are in themselves of
less importance than is the want of uniformity in the facts that
are omitted, both are to be traced in great measure to the
absence of system in the mind of the observer.

The defects point out the remedy so plainly, and the
advantages of a plan are so obvious, that it is almost superfluous
to disclaim any credit for originality in the suggestion. The
originality consists in the discovery, first, that in framing a plan
the qualities which are essential to efficiency are to be attained
by a close attention to nature ; and secondly, that the mechanical
difficulties which prevent persons from using a plan may be
entirely removed. If, in addition, the plan that I have adopted
shall commend itself, it will of course be a source of gratifica-
tion to me ; but I would prefer to see others adopt my mode
of forming a plan, rather than that they should tie themselves
to the particular form which at the present time seems best to
me. They should take my plan only so far as it is found to
be true to nature. The time may come, when parts of the body
which now seem to be as distinct from each other as the nerves
are from the vessels, may be seen to be as clearly connected as
are the arteries and veins ; and organs, of which we are now
accustomed to speak collectively, may be so much better under-
stood as to make it absolutely necessary to separate their
different symptoms. The plan that is sufficient to-day, may at
a future time be worse than useless.

Many plans have been devised. For the most part, each man
has his own ; but neither is any one plan generally adopted by
all, nor is it used by the same person for any length of time.
One attempt that has been made, though so complete as to leave
nothing apparently to be desired, may be taken as a type of all
the rest. The London Society of Observation, by the united
efforts of several, has elaborated a plan, which the lifetime of
one man could not have produced ; but the most ardent
admirers of this monument of industry, must acknowledge, that
it is unsuitable for general use. It is in that respect, like all
others that have gone before— a failure. By this, however, I
would not be understood to mean more than that, speaking from

my own experience, ordinary persons will be unable to use it. Two reasons may be given for this, without presumption. The habit which some have previously acquired of taking notes after their own plan, makes them indisposed to adopt another; and those who are deterred from using a plan, by the difficulties which attach themselves to even the shortest, are not likely to be attracted by one that has expanded into a small closely printed octavo. It is the length and the complexity of plans that is found so unmanageable. I shall, therefore, take special care that my plan shall be short and simple.

Nevertheless the thanks of the profession are due to the London Society for its praiseworthy attempt to introduce system into clinical study. The existence of the Society, and the issue of its work, mark an era in the history of medicine. The Society is an eloquent (though a comparatively silent) witness to the fact, that the sure foundation of medicine, as of every other science, is to be laid only on the careful observation of facts. So far am I from wishing to undervalue its work, that I indulge the hope that my present effort may be the means of making the volume to which I have referred, more generally used and appreciated. I also, with much pleasure, draw attention to certain records which appear from time to time in the public journals. Members of the London Society of Observation may be supposed to follow the guidance of their own work, in determining " what to observe." Be this as it may, the circumstance is note-worthy, that the reports which appear from the pen of some of the members, are remarkable for their cleverness, fulness, and precision; and they will bear analysis to an extent which can only be fully appreciated by those who have attempted to analyse the labours of other writers.

With this brief notice of that which comprehends, as it is in itself, a type of all that had been previously attempted, I proceed, as if no such attempts had been made; I lead my readers, step by step, over the ground which I have myself traversed in the construction of my plan; so that they may see that its comprehensiveness depends upon the way in which nature has been followed, and how that, under the same guidance and by removing difficulties one by one, simplicity has been attained.

It seems at first sight hopeless to expect that a plan can be devised, which shall be sufficiently comprehensive to include all the facts which ought to be observed, when it is remembered that these may be multiplied almost indefinitely, or, if this be thought possible, the variety of the facts seems to be so great, that we might well despair of making a plan sufficiently simple in its arrangement. These two characters, nevertheless, are

essential. Any plan that is to be really useful, must be so comprehensive as to serve for all cases, medical and surgical, acute and chronic, local and constitutional. At the same time, since "case taking" necessarily implies a certain amount of trouble, the plan must be so simple that the using of it must not add to the trouble materially, nor even at all, unless the immediate advantage is very obvious. Any semblance of inconvenience that may seem to belong particulary to the plan, must be immediately counterbalanced by something to commend it : the plan should offer obvious present advantage, as well as promise that the history itself will, by its use, be rendered more complete, and more practically useful. I believe that all this may be attained ; and further, that by simple attention to the nature and requirements of the case, a plan may be devised, which, in principle at least, shall commend itself to every one who cares to use a plan at all.

The almost certainty of coming short of that which is ultimately to be hoped for, and which it is reasonable to expect will be accomplished, does not appall me. I am satisfied to hope that my effort may be the starting point for others, who shall be more sussessful. To be a finger-post on the road that leads others to success in an important work is, in itself, a sufficient stimulus to exertion, and brings its own reward.

Of the two characters, simplicity and comprehensiveness, which I have specified as essential to efficiency, simplicity is the one that it is most difficult to preserve. Every fresh case suggests additions to, and modifications of, the plan that may have already been determined on. So that unless the outline be very distinct, and unless the headings have been chosen with strict fidelity to nature, so as to be comprehensive, a hopeless confusion is the result of this accumulation of materials.

It is, however, possible to arrange the facts of every clinical record under heads which shall be both few in number and distinct from each other. There are features which are the same in every case, however common it may be, or however peculiar. The uniformity of type, so to speak, is there, though it may be hidden ; simplicity will be preserved by bringing it to light. In the first place, there is a division of the facts into *past*, *present*, and *future*, which is inevitable. Every statement must be either history of the past, description of the present, or conjecture of the future. Again, the facts, under two at least of these primary divisions, naturally and of necessity group themselves under different heads, which are distinct from each other, but the same in all cases. For the record, whether of the past or present, is a statement of symptoms ; the symptoms

are the conditions of the different organs, or of the systems of the body. These organs and systems are sufficiently distinct from each other to furnish a well-defined outline, and being the same in all cases, the outline is the same for all.

It is in the notes made at the first interview of the physician with his patient, that the divisions into past and present are most noticeable; but between one visit and another, a longer or shorter time has elapsed, during which events have transpired, which are more or less worthy of note ; so that in the record of every visit, these natural divisions will exist. Moreover, there is a proper order to be observed. The report of the patient and of the attendants (the past history) forms the proper introduction to the personal observations of the physician (the present condition), whilst the prognosis, which is the conjecture as to the future, follows after all, as naturally as in the case of the other two, the one precedes the other.

In the like natural manner, the " previous history " and the " present condition " have six or eight subdivisions, according with the cutaneous, nervous, respiratory, and other systems of the body. This, therefore, is the natural basis for a plan, and shortness with simplicity is its first recommendation. But notwithstanding this, and that this general outline is so easily discovered in every case, and that the advantages of using a plan are so evident, it is in accordance with the experience of all, that in the use of a plan, practical inconveniences arise, which seem to be insuperable. Under special circumstances, e. g., in the time of an epidemic, a plan may be used; but very soon it is found under ordinary circumstances to be too severe a tax upon the patience, and it is given up. The inconvenience is partly due to a mechanical difficulty, and in part, is the necessary consequence of the attempt to make the plan sufficiently comprehensive. I hope to remove the mechanical difficulty, and I believe that the second source of inconvenience may be materially diminished, without marring the character of the plan for comprehensiveness. If the present attempt be successful, it will appear that in order to introduce system into clinical medicine, it is sufficient to insist upon the merest outline, such as I have already sketched, for ordinary cases ; and under special circumstances, as for epidemics and for cases which may be regarded as distinct, or which may naturally group themselves together, and which require more accurate investigation, special plans must be formed, keeping only the general outline the same for all. But whatever be the plan which is approved, the method by which it may be used with facility will be serviceable ; so that it is the method of using a

a plan, not the plan itself, that I put prominently forward. Before any plan, even the most simple, can be used, the mechanical difficulty of having separate columns or spaces for the different headings must be dealt with.

It seems at first sight to be necessary that the paper, on which the notes are to be taken, should be divided into parallel columns, or by transverse lines, into as many spaces as there are headings in the plan; but as we cannot tell beforehand which space to make large and which small, the inconvenience of this constitutes an almost insuperable difficulty; hence, the more common practice is to postpone tabulation till the case is complete; then, however, the defects *of the history are discovered, and, moreover, its continuity is destroyed. By a very simple device, this inconvenience may be obviated. I find that a method, similar in principle, is constantly in use among Conveyancers; mine will be better understood if I speak of it as a modification of theirs.

In making an Abstract of Title, the particulars are generally arranged under four distinct heads; and yet the writing must be unbroken. In order to this, margins of different widths are used; but always the same width of margin for the same subject. But, whilst "the law," in each subject, keeps the margins for the second and following lines, of the same width as for the first; I use the margin that is characteristic of any one subject (set of symptoms), for the first line only; and the second and following lines, in all subdivisions alike, are written across the whole page.

As a general rule, it is sufficient to have eight subdivisions; seven for the different systems—cutaneous, nervous, respiratory, circulatory, alimentary, urinary, and generative respectively, and one to spare for facts which cannot otherwise be classified. It is convenient to associate a particular number, the same in all cases, with each subdivision.

Number *one* is the number for general remarks, such as the posture in which the patient may be lying, the expression of countenance, the general impression as to his condition, which, though it is a conclusion, yet it is such an one as is often requisite to complete the picture.

Two belongs to the cutaneous system. Under this heading will oftentimes be found facts, which might, perhaps, more strictly speaking, be put under another head, *e. g.*, the flush upon the cheek, the venous hue as to the lips, might be arranged respectively as symptoms of the circulatory and respiratory systems; but inasmuch as this would involve the expression of an opinion as to the cause, and the cause assigned might subse-

quently be proved to be not the primary one; it is better as a general rule to state the facts simply as the eye sees them, rather than as the mind apprehends them.

The *third* subdivision stands for the nervous system. In this also there will be found facts, which may not be, strictly speaking, affections of the nerves. But, I remark, once for all, that provided the same symptom is always classified under the same subdivision, the exact place that is assigned to it is comparatively immaterial.

Four stands for respiratory symptoms. These are generally distinct from the rest. In no subdivision is the advantage of being able to compare symptoms, *pari passu*, with each other, more plain than in the respiratory. The facility with which, by the proposed method, the respiratory symptoms may be compared with those of the nervous, cutaneous, and circulatory systems, is all that can be desired.

Five is for the circulation. Under this heading also, may be arranged, in accordance with the theory of blood diseases, certain facts which may be characterised as " constitutional."

Six includes the alimentary symptoms, by which are to be understood those that relate to the whole alimentary canal, and to such abdominal organs as are not otherwise specially provided for.

Seven and *eight* are for the urinary and generative systems, and do not need further comment.

This natural subdivision of the symptoms has stood the test of the hurry that is incident to dispensary practice; so that it is almost superfluous to add, that it is of service in an hospital, and under circumstances where more time is at command. Yet but for the device to which I have alluded, even this simple arrangement could only have been followed in cases that were exceptional. The trouble of dividing one's paper into spaces or columns, might be incurred in studying any particular class of cases; but, for ordinary use, this would with me, as with others, have soon been thought superfluous and even disadvantageous.

My note-book, though it measures but four and a half inches across, happens to be marked with eight water lines, which run at about half an inch apart, from the top of the page to the bottom. At the top of each page, on the eight lines, the numerals 1, 2-8 are to be* placed. They refer to the different symptoms of the body, but they may represent at will, any other subdivisions. When, therefore, the fact to be noted has refer-

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* It is better to place the numbers at the head of the page only so soon as the corresponding symptoms are recorded.

ence, as it must always have, to any one system in particular, the sentence is commenced on the water line, at the head of which will stand the appropriate number. The next and following lines, if any, are carried directly across the page. Thus a cutaneous symptom begins under number 2 ; a nervous one under number 3, and so on ; and if, as may sometimes happen, there is doubt felt under which subdivision to classify any symptom—*e.g.*, whether to mention the colour of the lips as a cutaneous, or as a respiratory symptom—the sentence may be commenced under number 2 or number 4 indifferently; but the first time that the writing passes over the other line, the number should be introduced or a star (*) which, without causing any interruption, would draw attention to the fact that this system also is concerned.

When the principle is once understood, it admits of a great variety of modifications, and becomes applicable, under all circumstances whatsoever, wherein it is desirable to make a classification, without disturbing the existing order of things.

The following case of diphtheria will serve as well as any other for an illustration.

            3   4   5   6
Case.—H. A., (æt. 9,) 1, Little Welbeck-street, Aug. 16, 1859.
The fourth of six children.   One died of morb. cord.
            One of water on the brain.
He is cheerful and remarkably intelligent; his account of himself is given with an accuracy equal to that of an adult; he says that two days ago, after smelling some cayenne, had a sensation of burning in his throat, but that on the following day, he ate his dinner as usual and not till the afternoon did he feel poorly; he then complained of sore throat and went to bed early; this therefore I consider the *first day.*

Second day— Had vertigo.   He was also thirsty, and his throat was so painful that he could hardly swallow.

Fourth day—Is reported better under the application of *creasote.*
            P. 120.   Can swallow, with some, but not much difficulty; app. good ; t. inclined to fur; thirst somewhat less; b. not o since yesterday.   Rⁿ. 28, no cough.   The velum palati, and pillars of fauces, deep red, and angry looking; swollen to a somewhat greater exten on the right side, than on the left; behind the rt. pillar is seen a dirty purulent-looking mass ; it may be tonsil, but I cannot continue the inspection long enough to determine this, though the patient is submissive and makes a very good throat for me ; nor can I say positively that I can see the whole of the surface ; it looks more like a †slough than an exudation, but from henceforth I shall call it an exudation as diphtheria is prevalent.

Fifth day.— Says he is better.
            Rⁿ. 26, feeble, I can only count it by using the stethoscope ;   skin cool, no cough ; on asking him to breathe through his nose, the right nostril moist, the left rather dry.   P. 104.   Between the right st. mastoid and ramus of jaw, I can by feeling for it, find an enlarged gland, and it is rather tender ; t. dirty fur over the posterior half; I obtain a better view of his throat,

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† He says his " throat burst twice" yesterday, but he could not bring anything up.

2   3   4   5   6   7
by keeping the spoon on the tongue, till he retches; tonsil as before; the back of the pharynx distinctly seen, is of a dirty green colour, smooth as leather; b. o. twice; app. good.

Sixth day.—2. p.m.   At eight this morning had a distressing sense of suffocation; he pointed to the top of the sternum as being the place at fault; he is now lying on his rt. side asleep, and snoring; there is a guttural gurgling, and a dry sound with it, which seems to come either from the mouth or nares, and not from so low down as the larynx; his mouth is open; has no cough.
R^n. 21.   P. 112.
        The lips are pink and slightly * livid; there is seen beneath the right nostril, but only on very close examination a pinkish stain (as from fluid which had spread there); there are some red spots upon the outside of the finger and thumb of the rt. hand, he is inclined to perspire; but the exposed parts of the skin are cool.   He is rather puffy-looking about the neck and face, but I do not make out any particular swelling; when I feel of his neck, he is disturbed, turns over, but he does not thoroughly awake.
Thus far the treatment has been tonic, and stimulant; cinchona, iron and a little wine; and the topical application at first of nitrate of silver and subsequently of creasote. Antimony is now given; two gr. as an emetic, and gr. ¼ every six hours with calomel.
——— 8 p.m. asleep.   Coughs a little, not in my hearing; breathes with his mouth shut; snoring is more musical, less moist.
        Lividity, if any, not * perceptible by candle-light.
R^n. 20.   P. 100 very feeble.

Seventh day.—7 a.m.
        Not livid.   Has had difficulty of breathing, greater than now, at times during the night; dyspnœa croupal; he is constantly shifting his position.
R^n. 20.   P. 108.   No swelling at angles of jaw, but extension of jaw gives pain; fauces as far as seen look angry red; the top of the slough on the right side, seen with difficulty.
—2 p.m. No redness under nostril, none on finger, nor sign of any; lips rather pale, and rather   * dusky, but not enough so to be noticed if the breathing were not croupal; exp^n. is rather longer than $insp^n$. he points to top of sternum for pain. R^n. 20.   P. 108.   Stools green.
                        U. normal colour
sp. gr. 1031; on add^n. of NO_5 and boiling, turns inky; on add^n. of KO, a cloud which is not dispersed on boiling, but disappears on add^n. of acid.
—9 p.m. Pale; cool; but he is only covered with a sheet.
            Restless. R^n. 18.   P. 136.   Fauces, angry-looking with exudation on both sides; looks like a bad ulcerated sore-throat.
                    Gives a short cough after every two or three inspirations.
A consultation is held, and it is decided not to perform tracheotomy, but the antimony is to be discontinued.

Eighth day.—8 a.m. Looks lively; says he is better. I now feel glad that tracheotomy was not performed; last night I would have had it done at all hazards. R^n. 20. or thereabouts; noisy enough to count: sibilant; both $insp^n$. and exp^n. with distinct effort; cough dry, but succeeds in raising some muco-purulent clots.   P. 112.   No swelling at jaw.
        No lividity worth notice.
—— 2 p.m. A change! R^n. 32.   P. 108 failing.
        His face is livid and * there is livid pallor of limbs, with coldness; he sits fixedly in bed, afraid to move, with eyelids closed; or lies with his head and limbs outstretched; unwilling in either case to stir till obliged, as if reserving his little remaining strength in order to get breath; gives at intervals an ineffective cough, or suffocative screech.
The change took place two * hours ago; he then could speak, but was tossing about, and as if there were a string round his neck.

4

Necrosis 22h. after death.

There is redness of the trachæa, and a little membrane in the upper part; it is closely adherent to the ventricles of the larynx, and loose below; at the time that I saw it, after it had been floating a few minutes in water, it had lost its consistence, I was surprised to see so little. There is some appearance of membrane lining the left nostril, I should not have noticed it, had I not looked carefully for it. There was a quantity of muco-purulent secretion in the bronchi.

On comparison of the above case with the plan that is afterwards given some omissions will be discovered; had I now the opportunity these would of course be avoided. The case may, however, be taken as a sample of the way in which the general plan may be applied to any case that may present itself, and with this illustration before him, the reader will perceive the following obvious advantages of such a mode of observation.

The numerals at the head of the page, or the spaces that remain unoccupied, continually remind the observer that the record for any one day is incomplete until the organ which that number represents has been passed in review. This is at the time a great assistance, and for the future it is an assurance that any new symptom, which may arise, is not merely something that has existed before, and which was previously overlooked, but that it is, as it seems to be, a new symptom. Again, at the time of attendance the condition of each organ may be readily compared with that of the same organ previously, and thereby each observation acquires additional value; and subsequently, when the case is complete, it is all ready tabulated, without any re-arrangement of the facts, and without disturbing the proper sequence of events; so that the course of any one set of symptoms, either by itself, or *pari passu* with other symptoms, may be traced continuously through the whole. Finally, in after time, when search is made after any particular, which subsequent reading or experience has shown to be of significance; a single glance at the numbers at the head of the page, will tell whether a given case is likely to contain it; and if so, the eye is at once, and without fail, directed to the place where it may be found.

I now proceed to show how that, by taking the general plan for a basis, *special* plans may be formed. I take diphtheria as an opportune illustration of a method which I adopted at the time of the cholera in 1854, and which I have, therefore, since then had opportunity of testing. I cannot too strongly recommend this mode of study, previous to and concurrently with original clinical observation. Under the circumstances

just alluded to, it gave me a degree of confidence, which I should not otherwise have had; it enabled me from the first to turn my own experience to greater account; and it gave a definite aim to acts, which otherwise would necessarily have been more purely tentative and empirical. I venture, moreover, to promise the young student in medicine that such a course of procedure will help him to acquire a habit of accuracy; and his studies in proportion as they are less discursive, will be both more interesting and instructive.

Until we have a special plan for the particular case that we wish to study, the general one must serve. Circumstances more or less accidental, must at first guide us in the selection of the symptoms under each heading. Succeeding cases of the same disease will present some at least of the same symptoms, and, it may be, others in addition. In no long time, by collation of these symptoms we obtain what may be called a typical case, and this is the special plan that we require. We follow, but in a systematic manner, the mental process which in reality takes place in the mind of every careful student, and constitutes that which we call our experience of a given disease. Being performed designedly, the result is both more perfect in itself, and is arrived at more speedily; considerations, both of them, of practical importance sufficient to compensate for the trouble, even if it were much greater than it is. The trouble is, however, as we have shown, much diminished by using the general plan and by adopting the device which has already been explained.

I would gladly acknowledge the sources to which I am indebted for the construction of the plan which follows; but this is impossible. It is my constant practice to analyse, by writing out afresh, every clinical record that I meet with, and which bears upon the subject which I may be studying. The pages of the " Medical Times," of the " Lancet," and of the " Association Journal," with those of the different reviews of the last two years, supplied me in the first place with facts, and more than all, the monographs in the volume issued by the New Sydenham Society. The wards of St. George's Hospital and a few other cases in my own neighbourhood have given me the opportunity of digesting and assimilating these facts to a certain extent; and the form that I have adopted enables me to embody my own limited experience, without speaking dogmatically as to the nature of the disease, or as to the most successful mode of treatment.

TYPICAL CASE OF DIPHTHERIA.

2   3   4   5   6   7

A. PREVIOUS HISTORY.

   a. General, i.e., circumstances which relate to others besides the patient.

     i. Epidemic: evidence in proof, or to the contrary; age[1] of it.

     ii. Contagion: chances to which others[2] have been exposed.

     iii. Concurrence of other diseases.

       (1.) Among men, scarlet fever,[3] sore-throat, croup,[4] measles.[5]

       (2.) Among other animals.[6]

     iv. Season of the year; local hygienic influences.

     v. Hereditary[7] influence.

   β. Special,[8] *i.e.,* Circumstances which relate to the patient only.

     i. Length of exposure to epidemic influence.

     ii. Supposed source of contagion, date of exposure to it.

     iii. Existence of other disease prior to present attack.

     iv. Hygienic[9] influences.

     v. First symptom observed, date[10] of it; all future[11] dates to be from this.

B. PRESENT CONDITION.

   Aspect: general condition,[12] debility,[13] vigilantia,[14] expression of countenance, posture, previous treatment,[15] the effect of it, immediate or subsequent.

     Skin: general hue,[16] rash,[17] desquamation, bullæ,[18] diphtheretic[19] affections.   Nervous[20] affections, intellect,[21] motion,[22] sensation, special senses.   Respiration: frequency,[23] character, fœtor,[24] snuffling[25] (nostril), voice[26] (larynx), cough,[27] expectoration (bronchi).[28]

           Pulse:[29] frequency, force, regularity, effect of posture;[30] tendency of blood to coagulate.[31] External swelling[32] and tenderness, thirst, appetite,[33] deglutition,[34] state of bowels,[35] gums,[36] buccal membrane, tongue,[37] fauces,[38] tonsils, colour and condition of surrounding parts, and of subjacent tissue, exudation,[39] age[40] of it; (*a.*) in situ; (*b.*) after removal, as seen by naked eye; as seen under the microscope; the tissues involved; the mode of increase,[41] of departure.[42]   Albumen,[43]   casts, urea.[44]

C. CONCLUSION.   Recovery or death.

   Date of recovery: from time of seizure, from time of commencing treatment, from time of relapse.

   Do. do. of death: post-mortem appearances.[45]

Remarks.

1. The character of an epidemic varies so much in its progress, that it should always be stated how long it has been prevalent.

2. Members of the same family, or of the same household but not of the same parents (*e. g.,* children in a school, patients in an hospital, casual visitors), give valuable evidence bearing upon contagion.

3. The dispute whether a case is one of sc. fever, or sore throat, or diphtheria, is endless. If the facts are given, the opinion will be superfluous. The prevailing type, the rash[17], the affection of the throat, the condition of the urine, are the principal points, and may be given in few words. In each case it should be stated how soon the abnormal condition was observed.

4. State whether* the fauces were examined, and when; or whether it was *tacitly assumed* that the larynx was primarily affected. On visiting a district in Lincoln-shire, where I had been informed that there had been many cases of diphtheria, and but very few, if any, fatal ones. One of the most intelligent medical men of the neighbourhood kindly let me see a list that he had pre-served of all the cases, both of diphtheria and of other diseases, which had come under his notice during the pre-ceding months. He had not lost a single case of diphtheria; but his record showed three or four concurrent cases of croup, which had proved rapidly fatal. Post-mortem ex-aminations are " never made in that country," so that, in the absence of evidence to the contrary, I could not but suspect that some at least of the cases of croup were really fatal cases of diphtheria, and, therefore, that the success of the treatment had not been so uniform as was supposed.

5. A careful examination of the expectoration† in pulmonary affections should be instituted.

6. A farm servant, of much experience, and of more than ordinary intelligence, who lived in the district to which I have just referred, as one affected with diphtheria, told me that there had been at the same time and previously great mortality among sheep, pigs, and cows; and sickness among horses, but not more deaths among them than usual. Sheep and cows had been unusually liable to fatal inflammation of the lungs with effusion. Pigs and cows had died unable to swallow; he had seen a membrane on the tongue, and regarded its extension to the throat as the immediate cause of death. In some cases the hoofs of the feet and sometimes the hair of the trunk fell off. Horses also had been affected with sore throat; this he called influenza, and said that it was generally cured by blistering.

7. Cases have been noted in the same family, not only con-currently, but in different epidemics, and under different (?) local influences.

8. In the plan the *general* and *special* circumstances are separated, because it is important to remember that many facts must be viewed " generally " before their " special " relation can be rightly estimated. But in the narrative such a separation involves a repetition which would, for the most part, be unnecessary.

* See case of croup by Dr. Barker, Trans. Path. Soc. vol. x, p. 69.
† See 27, 28.

9. The hygienic influences should be noted, at the first visit, in respect of the favourable or other condition in which the patient has been placed; and also afterwards, occasionally, with reference to the treatment. Bretonneau attributed the serious effects of his heroic doses of mercury in part at least to excessive cold.

10. It is not always possible to fix the date of commencement; but whenever it is so the day and hour should be given.

11. All future dates should be stated as second, third, fourth, &c., day; each day being twenty-four hours complete, reckoned from the time of seizure.

12. A single remark at the commencement as to the general condition, though it be matter of opinion not of fact, is admissible, and it makes the reader better able to realise what follows. The authority for the statement should be shown by the introductory expression " He seems," or "Nurse thinks him," or " He says," the words of the patient being marked by inverted commas.

13. The prostration is generally out of all proportion greater than is to be accounted for either from the length of time during which the patient has been ill, or from the other symptoms. This is more remarkable in elder than in younger patients. It is, however, even more important to bear it in mind in the case of children; for in them the fatal termination is often most sudden and unexpected.* The child is thought to be going on well; is sitting up in bed playing with its toys; or it is taken up to stool: it gives warning scarcely sufficient to attract notice, and—it is dead! This occurs, sadly enough, more particularly among those who are convalescent.†

14. The wakefulness of patients, and at times a peculiar restlessness is the one fact which forbids a favourable prognosis when all else promises well.

15. In the MSS. it will be found convenient if *the treatment* is underlined; so that at any time it may at a glance be seen, both what it is, and what changes, if any, have been made in it.

The treatment may conveniently be summed up as I. Nutritive, and II. Medicinal. Nutrition in small quantities and frequently is of the first importance. Enemata should be given when from dysphagia or other cause food sufficient cannot be swallowed. Milk, or milk and water with cream, beef tea and wine, are generally taken without difficulty, and should be given at regular intervals.‡ The necessity for stimulants is so obvious, and they are for the

* See 30.   † See 31.   ‡ See 33, 34.

most part taken so willingly, that there is not much danger of forgetting the wine; but there is a fear sometimes lest the nurse should think that wine alone is sufficient nourishment. General depletion is not likely to be adopted; local depletion, as when there is great swelling of the glands of the neck, is not of the same temporary advantage as in scarlet fever. Mercury has few advocates. In Bretonneau's cases the advantage seems, as he himself at times suspected that it was, due to the topical influence on the exudation. The tincture of iron with quinine is most generally approved. Senega as an emetic and as an expectorant is strongly recommended when the disease has extended to the air passages, and the cough has begun to be moist.* The presumed increased liability of the blood to coagulate suggests the exhibition of ammonia; the sesquicarbonate as an energetic and diffusible stimulant might, therefore, be conveniently added. Where fatal syncope is feared the prone position should be insisted on.

The local treatment: Blisters, not continued beyond the commencement of vesication; not even till the epidermis begins to be elevated; it is sufficient for the surface of the skin to be slightly wrinkled. *a.* Hydrochloric acid (*strong*, the object being to destroy); unless the exudation extend out of sight, when the acid must of course be diluted; the application itself will produce swelling, so that the effect, whether beneficial or otherwise, cannot be determined till twenty-four hours have elapsed. *β.* Mercury. After tracheotomy had been performed, Bretonneau applied mercury to the inside of the trachœa and bronchi by insufflation, and apparently with benefit. Alum is recommended, and the injection of salt and water *per nares.*† Solid lunar caustic is the most common local application. Bretonneau used it in preference to hydrochloric acid, as being less painful and more efficacious; the only objection to it is that after a surface has been touched it is immediately whitened, and it is difficult, almost impossible, to say which is the effect of the remedy and which of the disease. This, however, is practically of little moment. The monograph of Britonneau is particularly worthy of study on account of the impartial evidence which it contains on the question of tracheotomy. Cases of all kinds are related; the operation is most carefully described in all its stages; and though many cases were fatal, yet others recovered from a

* See 27.   † M. Roche, Lancet, Aug. 20, 1859.

hopeless condition, so that it seems to me impossible to justify the practice which would allow any person to die without attempting this last resource even if it should only be in our power to perform it on a patient who is *in extremis*. The most important practical point in connection with the treatment of the patient after the operation is that care should be taken to use as large a tube as possible, and to keep it free from mucus or other impediments to a free passage of air. Even a double canula is something short of that which might be devised. Some adaptation of a spring is that which naturally suggests itself as being the best mode of keeping the artificial opening free, without narrowing the diameter of the trachæa, as must occur when even one tube is introduced. The form of tube which is imperfect on two sides, which, therefore, admits of more easy introduction than an incompressible cylinder, and which, when introduced, allows some air to pass by way of the larynx, so far as that is possible, is the nearest approximation that I have seen to that which seems to be wanted. When after death, we find a surprisingly small* quantity of membrane in the trachæa, or even in the larynx, the hope, that the persevering application to the throat of a sponge (Graves) wrung out in water, as hot as the hand can bear it, would in some cases be of service, seems to be rational. I have seen great temporary relief follow, even when the impediment to the breathing was some enlarged glands at the division of the bronchi.

16. The general hue of the skin, and particularly of the lips, is a very valuable monitor of mischief in the lungs, or rather of the degree of impediment that there is to the entrance of air into them. Petechiæ† have been found in some cases throughout the body.

17. The rash may be rapidly evanescent, so that it is safer to say " no rash seen," than absolutely that there was none.

18. Diphtheritic exudation has been noticed within bullæ, before the skin was broken, also beneath a blister before the cuticle has been removed.

19. To be looked for on any abraded surface, on wounds, on the conjunctivæ also.‡

20. The mental powers are commonly in full vigour to the time of death ; even children do not die in convulsion.§

* See 45.   † Pathol. Trans. x, 327.
    ‡ Mackenzie, Brit. Med. Journ. 1858, p. 53.
§ In a large proportion of cases convulsions in the infant answer to delirium n the adult. West, on Dis. of Child.

21. The affection of children is often unusually striking, and the intellectual faculties seem, in many cases, to be stronger than before the illness.

22. It is during convalescence that paralysis of the muscles of the palate, and of the voluntary muscles of the whole body is apt to occur.* More rarely the sight (Dixon) and hearing have been impaired. Recovery from these conditions may be confidently expected; though the improvement is usually tedious.

23. The number of respirations per minute should be carefully watched. Though all the symptoms promise well, save only that the breathing remains quick, it will be very hazardous to give a favourable prognosis. The character of the breathing is not always constant. It may be tolerably free at the time of the doctor's visit, whereas on inquiry we find that at times the patient has urgent dyspnœa.

24. Fœtor of the breath may be solely from decomposition of exudation that is in course of separation from the nostrils and fauces; and may sometimes be removed by chlorinated injection into the nostrils.

25. Bretonneau lays great stress upon this symptom, because it is so important that the disease should be recognized as soon as possible. He thinks that the disease not only spreads from the throat to the larynx, but from the nostrils to the throat;† and that if discovered in the nostril it may be stopped before the throat has become affected. He says, that the distinctive features of this affection of the nostril are that it attacks only one of them at first; and that the secretion excoriates the lip below that nostril, whereas in ordinary coryza both nostrils are affected. If the patient close his mouth and stop first one nostril then the other with his finger while he breathes, the condition of the open nostril is at once declared by the sound of the air as it passes through it. Some persons have ridiculed the remarks of Bretonneau as being too fanciful. There may be less in them than he supposes; but I am inclined to think that the subject has been dismissed too hastily by the critics, for I know how very easy it is to overlook such a condition of the nostril, so that I should place little reliance on the assertions of any who had not made a point of looking, and assuring themselves that the nostril is as free as they may think it is on a cursory examination.

* A very instructive case by Ransome, is to be found, Brit. Med. Journal 1859, p. 906.

† See 41.

26. The change in the tone of voice is one of the earliest
    indications that is given of the extension of the disease to
    the larynx.   It may sometimes be perceived if the patient
    is instructed to speak loud, when the ordinary tone of
    voice reveals nothing amiss.   In the same way a peculiar
    kind of snore may be heard during deep sleep (when the
    breathing is naturally louder), whereas while the patient
    is awake all seems as it should be.   The nurse, therefore,
    and attendants should be closely questioned, and instructed
    to report any such change that they may observe.
27. It is a favourable sign when the cough having been dry,
    becomes moist.   The expectoration though it may seem to
    be entirely of mucus, or of pus mixed with it, when well
    washed by being beaten up with water, may show pieces
    of separated membrane.   These, if present, will settle to
    the bottom of the vessel.
28. When the larynx is involved, the bronchi are so liable to
    become affected that the danger is, perhaps, greater lest it
    should be assumed too hastily that they are so, than that
    such a condition should be overlooked.   I have seen the
    assumption that there is disease of the lung turn the scale
    against the operation of tracheotomy, though it was the
    only resource that suggested itself; and after death all but
    the larynx was found free from exudation, and, as far
    as I am able to judge, there would have been a reasonable
    prospect of success.   One such instance is to my mind an
    unanswerable argument in favour of tracheotomy, even if
    the mortality were greater than it is.
29. There may be no febrile disturbance, but only a very feeble
    pulse; if the pulse is frequent, it is very rarely full.   When
    there is any fever, it does not bear any marked relation to
    the condition of the throat.
30. It is seldom necessary, and in some cases it is obviously
    undesirable,* to make the patient sit up for the purpose
    of observing the variation in the pulse, which is due to a
    change of posture.   But if the patient sit up for any other
    purpose the effect is noteworthy as an indication of the
    extent of the debility that there is.
31. The similarity in the mode of death in some cases of
    diphtheria to that† where clots have been found in the
    pulmonary artery suggests a point for further investi-
    gation.
32. The enlargement of the glands at the angle of the jaw,

* See 13.
† Humphry on the Coagulation of the Blood, pp. 23-31.   1859.

sometimes with pain in the ear, and with more or less tenderness of the glands themselves, is one of the earliest symptoms, and it remains almost longer than any other. The swelling is often so considerable as to be seen by the most superficial observer; but it may be so slight as to escape observation unless the parts below the ear and under cover of the body of the jaw are handled. When one side only of the throat is affected it is generally the same side on which the glands are enlarged.

33. Even when there is no marked difficulty of swallowing, the listlessness and indifference of the patient is apt to leave an impression that there is some special disinclination to take food, whereas it is only a general reluctance to make any exertion whatsoever.

34. The throat may be extensively affected, and yet no difficulty of swallowing experienced by the patient.

35. The bowels are generally costive.

36. The condition of the gums is very liable to be overlooked, people for the most part do not show their gums when they put out their tongue. The inside of the cheek is still less likely to be seen, unless it be specially examined.

About six months ago I noted for the first time an appearance, as of flour, on the gums of a person who was at least suspected to have diphtheria. It was considered at the time to be one of the characteristic symptoms of the case. Since then, however, I have observed a similar appearance on the gums of patients who were regarded to be suffering from other diseases, so that either it is not characteristic of diphtheria, or this is a diphtheritic character which has been engrafted on other diseases. Under the microscope the powder is seen to consist of epithelial scales.

37. The tongue is generally clean.

38. In examining the throat it is often very difficult to determine whether there is ulceration or not, and also whether there is exudation or not. The mark that remains after the application of nitrate of silver is very like a patch of exudation; and on the other hand a patch of exudation in the tonsil, especially if the surrounding parts be œdematous, looks exactly like an ulcer. The illusion is perfected if, in addition, the exudation is in shreds, partly decomposed, exhaling fœtor, and if the crypts of the mucous follicles are filled with exudation which looks like pus. The condition of the parts after death, or after recovery, will in some cases with difficulty convince a man that his

eyes deceived him when he spoke of " extensive gangrenous ulceration."

39. The term exudation is convenient, whether it be an exudation or not, provided that the description is given of what is meant by the term.

40. The region from which the exudation was removed should be named, and whether it is of that which has existed some time, or which has been formed quite recently.

41. It is of great practical importance to bear in mind that of the surface affected the progress is from above downward;* and also that in severe cases it is out of all comparison more rapid in the first twenty-four hours, than afterwards.

42. By separation of the membrane—by disintegration—by attrition.

43. Albumen is not invariably found. When present it may be detected much earlier in the disease than is commonly the case in scarlet fever.

44. Dr. Sanderson found the quantity of urea increased.

45. Attention will primarily be directed to the seat of the exudation as observed during life, and to its extension into the air passages, and more seldom into the œsophagus. The condition of the lungs and of the kidneys should also receive special notice. The disproportion that may be found between the morbid alterations and the fatal result is in accordance with that which obtains in other diseases which run a rapid course (Bretonneau).

CASES OF TREPHINING IN SYPHILITIC DISEASE OF THE BONES OF THE SKULL, WITH OBSERVATIONS.

By Henry Lee, F.R.C.S.,

Surgeon to King's College Hospital, and Senior Surgeon to the Lock Hospital.

PLATES IV. and V.†

Case 1.—Mary B., æt. 24, was admitted into the Lock Hospital, on the 23rd of February, 1860 ; she stated that six years previously she had contracted syphilis, which was followed by an eruption over the whole body. The eruption recurred, and after the lapse of three years appeared, from her description, to have resembled rupia. Eighteen months before her admission, she had a " very bad ulcerated sore throat." This had only recently healed.

Six months ago, she first noticed a painful swelling on the forehead, which increased to about the size of an egg, became soft, and gave way spontaneously, exposing the bone.

Upon her admission, she was extremely weak, much emaciated, and quite

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* See 25.

† The coloured plates illustrating Mr. Lee's paper will be published in Part VII.

unable to walk without assistance, the want of power being principally in the right leg. A piece of the frontal bone, about three inches in diameter, was exposed, dry, and dead. There were several nodes on different parts of the head, one of which had suppurated and burst over the right parietal bone, and another over the anterior extremity of the sagittal suture ; an extensive unhealthy looking ulcer existed under the chin and on the left side of the neck. This had completely detached the lobe of the ear from the side of the cheek (Plate IV). The patient was unable to hear anything said in an ordinary tone, but could understand when spoken to very loudly ; she seemed to have almost entirely lost the sense of smell. Sensibility on the right side of the face, including the right half of the upper lip, was impaired in a marked degree ; but there was occasionally tingling pain and, involuntarily, twitching of the muscles upon that side.

She was ordered a pint of the decoction of sarsaparilla daily, and had no other medical treatment.

February 29.—Has complained for the last few days of pain over both clavicles, and last night a node over the right one gave way, leaving the bone exposed.

March 5.—Has now sufficient strength to walk about the ward without help ; she still, however, appears weaker on the right leg than on the left. The ulceration on the neck is spreading.

Operation, March 8th.—A crown of a large trephine was applied near the centre of the exposed frontal bone, to the left of the median line, and the entire thickness of the bone removed. The exposed dura-mater bled from a few points, but presented elsewhere an opaque white surface, which did not bleed. The internal table of the removed portion of bone was very vascular and soft. The surface which had been in contact with the dura-mater was roughened in a very peculiar manner, presenting numerous elevations and spiculæ of bone, and having the appearance of having been extensively worm-eaten. The accompanying drawing (see Plate IV), by Dr. Westmacott, taken two or three days after the operation, shows very accurately the condition of the internal table of this portion of the bone, and the appearance of the part from which it was removed. The middle and external table had entirely lost their vitality.

March 10.—Yesterday morning, and again this morning, on waking, she had strabismus of the right eye, which lasted for two or three hours, and then disappeared.

March 14.—The strabismus has returned every morning since the last report, but this morning it was not seen.

March 20.—No return of the strabismus. Granulations have formed upon the dura mater. She complains of much pain about the ulcers on the neck. The hearing is decidedly improved.

March 21.—Feels much better in every respect. The sensibility of the right cheek has returned. Very slight pain in the neck.

March 27.—She can now hear perfectly when spoken to in an ordinary tone ; is gaining flesh rapidly.

April 5.—Is free from pain, and able to go down stairs and walk in the garden.

May 1.—The ulceration on the neck is quite healed. She now hears quite well. There is still some numbness on the right side of the upper lip. With this exception sensation is perfect.

There was no return of the muscular twitchings, nor of the insensibility

during the months of May and June; slight numbness of one half of the upper lip, still however, remained.

Case 2.—Mr. ————, a tradesman in the city, came under my observation on the 3rd of March, 1859. He gave no distinct history of any primary syphilitic affection, but a well-marked and accurately-defined induration existed at the upper part of the root of the penis.

Eight years previously, an ulcer made its appearance on the forehead, immediately over the left eye. This spread rapidly in every direction; about the same time the skin over the right elbow began to ulcerate. This ulceration extended upwards and downwards, and involved the skin of the whole arm. The ulceration on the forehead healed, but that on the arm had never entirely done so. Three years after the commencement of this ulceration, he had a severe convulsive fit; he was not insensible, but there was violent contraction of the muscles of the jaw and back. During the continuance of the spasm no food could be administered. The muscles of the face were likewise affected.

In the year 1857, it became evident that the bones of the skull were extremely diseased. He was now one day suddenly seized with violent spasmodic contractions of the right side of the face, which lasted half-an-hour, without loss of consciousness. Four months later, a second attack followed of a more severe character. This lasted six hours and a half, was accompanied by partial paralysis of the right side of the body, and tremor of the limbs. Subsequently to this, several milder attacks occurred, and increased in frequency. He always had a warning of these attacks. His face became flushed, there was a difficulty of articulation, and tremor of the muscles on the right side of the face.

This patient underwent a great variety of treatment by different medical men, and was, for a considerable period, out-patient at St. Bartholomew's Hospital. On the 13th of September, 1859, he was admitted into the Lock Hospital; an ulcer still at that time existed on the outer side of the right forearm. The cicatrized skin from the shoulder to the wrist, firmly bound down the parts beneath, and the arm was, in consequence, very much reduced in size. There was no motion either in the elbow or wrist joints. The hand was greatly swollen and œdematous. The frontal and parietal bones were in several places denuded. Extensive portions of their outer tables were either carious or necrosed.

Operation.—All ordinary remedies having been previously exhausted, this patient was placed under the influence of chloroform, on the 25th of October, and the trephine applied in several places over the right parietal bone. In the part apparently the most diseased, the whole thickness of the skull was removed, to the extent of one crown of the trephine. In other places, the outer and middle tables only were taken away. The exposed dura-mater, where the whole thickness of the skull had been removed, bled freely, and did not appear to be covered by any deposit. The surface of bone which lay in contact with it, was slightly eroded, but not nearly to the same extent as in the previously recorded case. It was also perforated by numerous very minute holes.*

October 26.—Had slept well during the night.

November 5.—Had two fits last night similar to those he had had previous to the operation. They were reported by the house surgeon as "of and epileptic character, accompanied by loss of voluntary power."

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* The portion of bone which was at first carefully preserved, was, subsequently, accidentally lost.

November 12.—General health improved.   Healthy granulations from the scalp.   The ulcer on the arm showed a disposition to heal.

November 27.—Had a slight fit which lasted about a quarter of an hour. During this time he was quite conscious, but the lower jaw was fixed, and the muscles of the face were slightly convulsed.   From this time until he left the hospital, on the 23rd of December, there was no recurrence of the fits.   The wounds in the scalp assumed a healthy aspect, although there were still some small portions of bone which remained uncovered.   The wound in the arm became reduced to the size of a fourpenny piece, and he had evidently gained much in health and strength.*

Case 3.—A farmer, æt. 42, with a remarkably well-developed frame, was admitted into the Lock Hospital on the 2nd of October, 1858, and died on the 12th of November following.

For six years this patient had suffered from severe pain in different parts of his head, and extensive ulcerations, especially upon the right leg.   The left eye and left nostril had been destroyed by ulceration.

Extensive portions of bone had exfoliated at different times, principally from the right side of the upper part of the skull. The original seat of pain corresponded to the upper part of the occipital bone; on the 4th of November this patient became paralytic on the whole of the left side.   He was slightly delirious and subsequently comatose.

On the 11th of November, a trephine was applied near the anterior and inferior angle of the right parietal bone, but nothing was met with to account for the symptoms.

On a *post-mortem examination* the whole of the organs were found in a remarkably healthy and well-developed state, with the exception of the brain and its coverings, and the remains of the ulcerations above mentioned.

The outer table of the skull had disappeared over a large part of its surface.

The diploe throughout was filled with bony deposit, and was of the same consistence as the other tables.   Extensive portions of the frontal and both parietal bones were deficient in their entire thickness.   The upper part of the occipital bone, corresponding to the original seat of pain, was carious.   A circumscribed portion of the inner table of the right parietal bone was apparently necrosed, but the outer table in this situation retained its vitality.   (See Plate V.)   One of the portions of bone

* This patient continued to show himself at the hospital occasionally, until midsummer following.   The ulceration on the arm entirely healed, having been open between eight and nine years.   The exposed scalp became covered, with the exception of a few very minute portions of bone.   He had two or three slight attacks of the twitching of the muscles of the face, but no recurrence of the fits; with the above exceptions, his health appeared to be permanently re-established.

removed by the trephine was within a quarter of an inch of this portion of necrosed bone.

Corresponding with these diseased portions of bone, the dura mater was covered by a tenacious brown semi-fluid material. The adjacent surfaces of the arachnoid were glued together by a similar effusion. The brain had, in different parts, undergone various stages of red softening, which it will not be necessary here further to detail. It was presented, while in a recent state, to the Pathological Society ; and a description of the appearances, together with a plate by Dr. Westmacott, are published in the 10th Volume of that Society's Transactions. It is important however to remark that the disease of the brain was most advanced in those parts which corresponded to the disease in the bone, and that immediately opposite the affected portion of the occipital bone on the left side of the median line, where the pain had commenced six years previously, the brain substance was softened down to the consistence of cream. There was no disease of the brain or its membranes in those situations where the entire thickness of the skull had been removed.

OBSERVATIONS.

In cases of syphilitic caries and necrosis of the bones of the skull, the outer and middle tables are alone generally diseased ; or, if the internal table is affected, it is to a small extent only, and in places where the outer table has already perished.

One reason of this may doubtless be found in the fact that the internal table of the skull has an independent supply of blood from the vessels of the dura-mater, and its vitality may be preserved quite independent of the external table. For the same reason, the internal table of the skull may become the seat of a disease which does not affect the outer table, and may be necrosed, as in Case No. III, or carious, as in Cases No. I and II, without the external table being similarly affected. In such cases, the disease of the bone occasionally leads to the effusion of serum, lymph, or pus on the surface of the dura mater ; and the secretion thus produced, together with the diseased portion of the internal table, becomes confined by the outer tables of the skull which may remain in a comparatively healthy state. In Case No. III the disease commencing in the bone, extended by continuity of action first to the membranes of the brain and then to the brain itself, and produced no disease (except such as may have resulted from morbid nervous influences) in any other part. In the other two cases the con-

dition produced by the disease of the bone was not confined to its immediate neighbourhood. In the first case it seems to have extended from the dura-mater lining the frontal bone to the base of the skull, and then to have affected the seventh pair of nerves, and the second division of the fifth nerve upon the right side.

In the treatment of cases where the internal table of the skull has become involved, the removal of the carious, or necrosed, portions affords the best, if not the only, means of preventing the progress of the disease.

This is often accomplished by nature : but here, as elsewhere, artificial means may be used when the powers of nature are not sufficient to accomplish the intended object.

In illustration of this subject, it must be remarked, that in those places, in Case No. III, where the entire thickness of the skull had been removed, there was no disease either of brain or of its membranes ; but that in those situations where the diseased bone had been maintained in contact with the dura-mater, effusion on the surface of the membranes, and softening of the corresponding portions of the brain had occurred.

It can rarely happen in these cases that the whole of the diseased internal table of the skull can be removed artificially ; but it appears from cases No. I and II that the removal of even a comparatively small portion of the internal table has a very marked effect in relieving the irritation of the membranes of the brain. This may depend firstly and principally upon the facility that is thereby afforded for the free discharge of any fluid secretion through the opening in the bone, and, secondly, upon the establishment, from one part of the dura mater, of a healthy suppuration.

One of the most prominent symptoms, and one which gave the greatest inconvenience to the patients in the above-related cases, was the recurring, persistent, and extensive alterations of portions of the skin. These ulcerations were upon the side upon which the bones of the skull were principally diseased. If they depend, as I shall endeavour to show they do, upon deranged nervous influences, then it appears that such nervous actions, in their transmission from the brain, follow a law different from that which obtains with regard to ordinary sensation and voluntary motion. The same, and not the opposite side of the body, is affected to that on which the irritation, or the paralysing influence, is applied. To this rule, a rather remarkable apparent exception presents itself in the third of the above-mentioned cases. The left eye was lost, and the nostril was closed, in consequence of ulceration ; and yet the greater part of the

diseased bone was upon the right side of the head.   But this
exception is apparent only.   The affection of the eye and nose
occurred in a comparatively early period of the case ; and at
that time the pain at the back of the head was one of the most
prominent symptoms ; and here it was that ultimately a portion
of the *left* posterior lobe of the cerebrum became softened down
to the consistence of cream.

Dr. Brown Sèquard* has shown, experimentally, in how
great a degree the supply of blood depends upon the ·nervous
influence in a part.   If this nervous supply be cut off, the vessels
dilate, the parts become warmer than natural, and the processes
of nutrition are necessarily affected.   These results appear on
the same side of the body upon which the nervous lesion has
been produced.   If diminution of nervous influence is followed
by an increased flow of blood through the vessels of a part, it is
more than probable that an increase of nervous action or irrita-
tion would be accompanied by some corresponding change.

Dr. Brown-Sèquard has also shown how readily epileptic
fits may be produced when certain nervous influences have been
mechanically interfered with.   In case No. II the convulsive
attacks bore some resemblance to those produced artificially in
some of the Brown-Sèquard's experiments.   The flushed cheek
indicated the dilated condition of the vessels, and the fits which
followed this peculiar warning were somewhat similar in kind to
those occasioned by artificial means.

Early in the present century Majendie showed, in his
experiments on the branches of the fifth nerve, that the
abstraction of nervous influence was liable to be followed by
ulceration of the cornea.   The same fact may be proved by
clinical observation.†

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* See Dr. Brown-Sèquard.   Lectures delivered before the College of Surgeons.
Lancet, Lect. X and XI, Nov. 1858.

† Richard Hill, 51 years of age, became an inmate of St. George's Hospital
on the 1st of September, 1841, having about 7 weeks previously received a severe
blow from a heavy piece of timber upon the left side of his head.   He was
rendered perfectly insensible by the accident, and lost a considerable quantity of
blood from the ears, nose, and mouth.   On the following day, when he regained
his senses, it was found that the right side of his body was completely paralyzed,
and that there was ptosis of the left eyelid.   On his admission into the Hospital,
he complained of much pain in the head, and especially on the left side.   The
ptosis continued, and there was a discharge of pus from the left ear.   He had
recovered from the paralysis of the right side, but was still extremely weak,
especially in his lower extremities.   The left eye was turned inwards, and the
pupil much contracted.   He had lost all sensation in the left side of the face and
upper part of the head.   He could neither taste nor feel upon the left side of the
tongue, except at its root, nor was he at all conscious of any sensation when a
probe was introduced into the left nostril.   The same want of sensibility might
be observed in every part to which the branches of the fifth nerve are distributed.

If it be then admitted that certain disturbing nervous influences will alter the supply of blood to parts of the body, and if it be further shown by direct experiment and observation that alteration of structure and ulceration may be produced thereby ; then can there be no difficulty in admitting that the extensive and persistent ulcerations observed in all the above-mentioned cases may have depended in a great measure, if not entirely, upon morbid nervous influences resulting from disease in the bones of the skull. These observations, taken in conjunction with the results of Majendie's experiments, apply with peculiar force to the destructive ulceration which affected the left eye and left nostril in the third above-recorded case.

CASES ILLUSTRATING THE FORMATION OF SO-CALLED "FALSE MEMBRANES," IN CONNECTION WITH THE IMMEDIATE COVERINGS OF THE BRAIN ; WITH OBSERVATIONS.

By JOHN W. OGLE, M.D., OXON,

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Continued from page 284, Vol. I.

PLATE VI.

Case 7.—*" False Membrane" attached to the inner surface of the Dura-Mater, from a case of Phthisis.*

The case was that of a man, C. N., aged 21, who died in St. George's Hospital, 1858.

Previous History.—The patient had been living miserably some time in Paris as a metal-chaser. For six months he had been the subject of cough and pain in the left side, and had been vomiting much.

Symptoms on admission.—There were unequivocal signs of vomicæ in the lungs, and bed sores existed on the back to a considerable degree. He died about 14 days after admission into the Hospital.

POST-MORTEM EXAMINATION—*Thorax and Abdomen.*—The lungs contained large numbers of scrofulous deposits, and vomicæ of considerable size. On the left side the pleural adhesions were very numerous, and the pleura itself unusually thick and indurated, having at one part attained the thickness of half an inch, and acquired the outward appearance of a layer of cartilage. On the

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The cornea in this case gradually became opaque, and remained so for several years, during which this patient remained under the author's observation. The left side of the face did not recover its sensibility.

right side the pleural adhesions were seen to contain a great number of finely injected blood vessels. The other thoracic and all the abdominal organs were natural.

Cranium.—The scalp, cranial bones, and cerebral membranes were all natural, but coating the under or free surface of the dura-mater covering the upper part of both cerebral hemispheres, was found a very thin and diaphanous layer of fibrin, adhering to the dura-mater with considerable tenacity. This film was perfectly free from colour, excepting occasional bloody puncta and slight masses of reddish colouring matter. Unfortunately I did not examine the membrane to ascertain its precise and microscopic characteristics.

Case 8.—*" False Membrane " attached to the inner surface of the Dura-Mater.—Softening of the Brain.—Hemiplegia following a " Fit."*

The patient was a man, J. G., aged 62, who died in St. George's Hospital in 1856.

History.—Nothing was ascertained of his previous life excepting that he had had some sort of " a fit " eight days before admission, during which he had lost consciousness, and which was followed by hemiplegia on the left side and complete inability to articulate. The urine was found to contain much albumen and pus, and waxy casts of urinary tubes.

In two or three years he was able to get out of bed, and by degrees there was a slight return of power in the affected arm, but the facial paralysis and loss of speech continued. In about a month's time he was able to utter a few words; but two weeks latter he was attacked by a peculiar kind of seizure in which both arms were very convulsed for about an hour, and he was in a semi-comatose state, having at intervals fits of excitement, calling out loudly. Exhaustion became extreme, and he became very noisy and unable to sleep. He died 11 weeks after admission.

Treatment.—Consisted of counter-irritation with purging, along with the use of wine and ammonia.

POST-MORTEM EXAMINATION.—*Thorax.*—The lungs were much gorged. The walls of the left ventricle of the heart were much thickened, and there was some atheromatous deposit in the coronary arteries and the mitral valve-flaps.

Abdomen.—The kidneys were very granular and cysted, and in the left one was a small abscess found to be communicating with a large accumulation of pus behind the kidney, which passed through the various lumbar muscles of the part, and occupied a portion of the left psoas muscle. No diseased bone existed, and this condition of things was apparently connected with large sloughs and bed sores on the back.

Cranium.—The cranial bones were rather thinned. The dura-mater was healthy itself; but lining it on both sides of the false cerebri, corresponding to the upper part of the cerebral hemispheres, was a thin but substantial layer of fibrine, of a pinkish colour, owing to its being stained with blood admixed. The arachnoïd membrane covering the vertex as well as the base of the brain was much thickened and opaque in patches, and much sub-arachnoïdean fluid existed.

A large portion of the upper and middle part of the left cerebral hemisphere was found extensively softened, the softened parts being chiefly of a greyish hue, except at the surface where it was yellowish in colour.

Case 9.—*" False Membrane" lining the Dura-Mater covering both Cerebral Hemispheres; from a case of Carcinoma of the Liver.*

The patient, a woman, R. P., aged 33, died in St. George's Hospital, 1853.

Previous History.—She had been for two years previously subject to sickness and vomiting of bitter and acid fluid from the stomach ; and two months ago she had had pain, attended by swelling, in the right hypochondriac region.

Symptoms on admission.—The skin generally was of a yellow hue. The bowels were confined. There was a firm growth of some kind apparently in connection with the liver, of considerable size, and the seat of much pain on pressure. After a time the patient's countenance assumed a highly cachectic appearance, and it seemed probable that the disease was one of a malignant character. After a temporary improvement the hard growth rapidly increased in size, extending quite across the abdomen.

The patient became extremely emaciated, aphthæ appeared on the lining of the mouth, and she sank from exhaustion several months after admission, the mental faculties and all power of muscular movement being retained to the last.

POST-MORTEM EXAMINATION.—The body was greatly emaciated, and presented several purpuric spots on its surface.

Thorax and Abdomen.—The right pleural cavity contained much serous fluid which greatly compressed the lung. The left lung was congested at its apex, contained some scrofulous deposit.

The liver was extensively affected by carcinomatous growth, partly of the so-called fungoïd, and partly of the melanotic form. The other abdominal organs were natural.

Cranium.—The scalp and the cranial bones were natural. The brain was natural. The cerebral membranes were themselves also natural ; but lining the free surface of the dura-mater, as it covered the vertex of either cerebral hemisphere, was a consistent layer of soft yellowish-coloured fibrin. Nothing unusual was noticed about the sub-arachnoïd spaces.

Case 10.—*" Thin False Membrane" of soft fibrinous material lining the Dura-Mater.—Disease of the Spleen and general Lymphatic Glands following Fever.*

The patient, a woman, aged 39, died in St. George's Hospital, 1856.

Previous History.—She was a housemaid, who had enjoyed good general health until she had a smart attack of fever one month before she became an inmate of the hospital ; during her recovery from the fever she found an enlargement in the left hypochondrium which continued to increase in size.

*Symptoms on admission —*The general appearance was cachectic. The pulse was very frequent, and the bowels costive : there was much distension of the abdomen and indistinct fluctuation. No vomiting. Much uric acid existed in the urine. In spite of treatment the abdominal distension increased, and she became the subject of an erysipelatous attack of the scalp. Subsequently, fluctuation became very decided in the abdomen, and dyspnœa, along with albumen in the urine and much enlargement of the lymphatic glands in the groin and neck came on. She died about a month after admission.

POST-MORTEM EXAMINATION.—*Thorax and Abdomen.*—The pleural cavities contained very much turbid fluid; and an increased quantity of fluid existed in the pericardiac sac. The heart was healthy, but the lymphatic glands about the root of the aorta were very large and indurated.

The general cavity of the abdomen contained much clear fluid. The spleen was very enlarged, weighing 4 lbs., and was the seat of a peculiar deposit of a brown and yellowish-white colour; and similar deposit existed in the substance of the liver and in the dorsal, lumbar, pelvic, femoral, and iliac lymphatic glands. The kidneys were highly granular, &c.

Cranium.—The scalp and cranial bones were natural. The dura-mater covering the upper parts of the cerebral hemispheres, was lined by a very thin layer of soft fibrine, discoloured by specks of bloody colouring matter. The cerebral membranes themselves, as well as the substance of the brain, were quite natural. The cranial sinuses were natural.

Microscopical Examination.—The enlargement of the various sets of lymphatic glands, as well as the peculiar masses of deposit found in the liver and spleen, were found to be owing to the presence of peculiar cell-bodies chiefly resembling, for the most part, the white corpuscles of the blood.*

Case 11.—*" False Membrane" lining the inner surface of the Dura-Mater, from a case in which one of the Cerebellar, as well as one of the Coronary Arteries, was found to contain a Fibrinous Plug.—Fibrin adherent to the inner surface of the Heart.*

The patient, a boy, aged 16, died in St. George's Hospital, 1856.

Previous History.—He had enjoyed good health until 3 or 4 days before admission, when, after a longish walk, he became affected by pain in the head; and after supper had an attack of sickness. On the following morning he became unconscious, and had been so ever since.

Symptoms on admission.—His general aspect was rather that of one suffering from fever. The pulse was 140 per minute. The urine was found to contain much albumen. The night was passed in a very restless condition, and on the following day he died.

POST-MORTEM EXAMINATION.—*Thorax and Abdomen.*—The pleural membranes and lungs were natural. The heart was, as to cavities, walls, &c., natural; but a large amount of old-standing and softened fibrinous material was found in connection with the flaps of the mitral valve, and upon the inner surface of the left auricle of the heart; and a plug of fibrine was met with in a branch of one of the coronary arteries, at which point the artery was dilated to almost the size of a large pea.

Masses of fibrinous material were also found in the substance of the spleen and kidneys, and also lying attached to the mucous surface of part of the colon.

Cranium.—The scalp and cranial bones were natural. The brain itself was quite natural, but its vessels were congested. A branch of one of the cerebellar arteries on the right side contained a small fibrinous plug; and in the super-

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* The exact description of these cell-bodies, as well as that of others found in the blood of the splenic and azygos veins, will be seen in vol. xi of the Transactions of the Pathological Society, p. 247, where, owing to the peculiar enlargements of the glands, the case is given at large.

ficial part of the corresponding portion of the cerebellum blood was found extravasated, equal in quantity to the size of a pea. On examining the dura-mater, its inner surface, where covering the upper part of both cerebral hemispheres, was seen to be lined by a thin layer of reddish fibrin which was slightly adherent to the membrane. This layer existed to a greater extent on the dura-mater covering the right side of the brain.

Microscopical Examination.—The soft layer coating the dura-mater was found to consist of a simple, almost homogeneous structure containing only oval nuclear bodies, with also, here and there, delicate processes like young blood vessels.

Case 12.—*" False Membrane" lining the Dura-Mater in parts, from a case of Phthisis.*

The patient was a woman, C. S., aged 31, who died in St. George's Hospital, 1856.

History.—The symptoms were those of phthisis simply, nothing further of note presenting itself. She gradually sank and died.

POST-MORTEM EXAMINATION.—*Thorax and Abdomen.*—Scrofulous deposit and vomicæ were found in the lungs and also in the liver and kidneys, and connected with the peritoneum.

Cranium.—The cranium bones were natural. The dura-mater generally was natural ; but lining its inner surface at the anterior part, and on both sides of the falx, was a coating of fibrine of a pinkish-white hue, and capable without difficulty of being peeled off, the dura-mater. The left lateral sinus contained a quantity of old-standing fibrinous clot partially undergoing change.

Scrofulous deposits were found in connection with the arachnoïd membrane in various parts.

Case 13.—*"False Membrane" lining the Dura-Mater.—From a patient who had a Cyst in the Brain of old standing, but who died with Abscess in the Pelvis, in connection with diseased Prostate.*

This case was fully described in the "Transactions of the Pathological Society," * on account of the cyst in the corpus striatum and the attendant partial paralysis of the arm and leg of the opposite side of the body. It was then mentioned, but the fact was not dwelt upon, that the dura-mater was in many places very adherent to the calvarium, and that lining the dura-mater to some extent over the cerebral hemispheres, a thin layer of false membrane existed, here and there blood-stained, but otherwise almost discoloured. On *microscopical examination* of the delicate false membrane vast numbers of delicate fibres with large distinct oat-shaped nuclei were seen, and occasional very large round and oval bodies with dark refracting contents ; and also much granular matter, red and white blood corpuscles, and "distinct capillary vessels" with regular nuclei in their walls.

History.—The patient was a man aged 62, whose mind had always apparently been affected, and also was said to have been partially paralyzed since a child. He was brought into St. George's Hospital owing to retention of urine and enlarged prostate, and sank and died three weeks after admission. After death

* Vol. vii. p. 8.

the urinary bladder was found very inflamed and the prostate enlarged, and there was a false passage at the posterior part of the cavernous portion of the urethra leading into a sloughing canal, and abscess between the bladder and rectum. The kidneys were also granular.

Case 14.—"False Membrane" attached to the Inner Surface of the Dura-Mater, and forming a Cyst containing the remains of a clot of extravasated blood.

This specimen consists of a portion of the dura-mater having attached to its inner surface a double layer of thin, soft, false membrane easily lacerable, which originally formed a cyst containing coagulated blood. This membrane has been divided in two or three places, so as clearly to expose a large portion of the contained clot, which is seen to be very shrunken and mostly, but not entirely discoloured. At the upper part of the preparation the false membrane may be seen reddened by red puncta. In one or two parts the opposite walls of the membranous bag are firmly united to each other by dense fibrous tissue; and in other places, (the adhesion having been broken through) remnants of intervening tissue are seen pendant from the surface.

Microscopical Examination.—The whole of the false membrane presented a delicately fibrous structure, the fibres being for the most part wavy, and containing, although sparingly, small oval and round cells. No blood vessels could be seen in any part of the membrane.

The contracted blood-clot was seen to present the ordinary appearance of such substance.*

History.—This I regret to say is altogether wanting, as also all particulars of the rest of the post-mortem examination.

Case 15, *with Plate VI.—Epileptic Convulsions connected with Dentition.—Large amount of False Membrane lining the Dura-Mater in almost every part.—The Brain in general hardened but in some parts softened.*

The patient was a boy aged 2¼ years, who died under the care of Mr. Cæsar Hawkins.

History.—The child had been always in good health until he was two months old, when he suffered much from dentition. Considerable febrile disturbance accompanied the protrusion of the teeth, attended by several convulsive seizures, which continued at variable intervals during the rest of the patient's life.

Symptoms.—The convulsive attacks, which were such as are wont to exist in children, connected with teething, were followed by unconsciousness lasting for the period of a week. The child was quite insensible to the calls of nature except that of hunger. He could not stand on his legs but he could freely move them. The pupils became very dilated and inactive to the influence of light, and frequent general convulsions for the space of ten days preceded death.

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* The preparation is now in St. George's Hospital Pathological Museum, as No. 1. b. Subseries vi, Series xxi.

In the same section numbered 2. 3 and 4, are three other cysts with dense walls, which originally contained blood, and were found in the arachnoid cavity. Two of these are described by Mr. Hewett, in the "Transactions of the Royal Medical and Chirurgical Society," vol. xxviii, page 61, and the other is described in vol. vi, of the "Transactions of the Pathological Society," page 8, by Dr. Quain and Mr. Hewett.

Post-mortem Examination.—*Cranial Cavity.*—The cranial bones and the integuments covering them were natural. The dura-mater itself was natural; but lining the inner surface of this membrane to a great extent, as it covers the cerebral hemispheres on both sides was a very thick layer of firm fibrinous material.*

This layer was originally no less than about three lines in thickness in most parts. The inner surface of almost the entire dura-mater was lined by this membrane, *see Plate* VI., a portion at the base of the cranium only, for a short space around the optic nerves being excepted. Between the membrane just described (the so-called false membrane) and the surface of the visceral arachnoïd, (*i.e.*, in the so termed arachnoïd cavity) about half-a-pint of serum existed ; and beneath the proper arachnoïd membrane which was slightly firmer and thicker than usual serous fluid existed also. This thick membrane lining the dura-mater, I have been enabled to divide and split up into several layers (*c. c. c.*) and of these subdivisions, the outer one is of great tenuity and almost translucent, and the innermost layer is of a like character, but of a rusty-brown colour towards the vertex of the cranium, and rather roughened on its surface. The middle-most layer is very thick and has a parchment-like character, and is also of a rusty-brown hue, possessing, moreover, several projections of an opaque substance on both its aspects, which, as well as the roughnesses adverted to in connection with the innermost layer were evidently of the same nature as the fibrinous membranes themselves, and were simply formed by accumulations of fibrine around the several small vessels, which passed through the false membrane, and which are well known so frequently to exist in the neighbourhood of the great superior longitudinal sinus, passing from the surface of the convolutions to join the veins within the dura-mater. At least this is the only interpretation which suggests itself to any mind, of these mammillated elevations. On either side of the falx cerebri, and at the angles formed by this portion of the dura-mater and the other portions, exists a thick rounded pedicle-like mass (*d. d.*) cut abruptly across and presenting several rounded apertures where the section has been made. Through one of these openings I have passed a bristle, and this is seen to enter the superior longitudinal sinus, with which, in fact, all the openings communicate. This mass, looking so much like a pedicle, is, without doubt, formed by the matting together of several veins just before their termination in the sinus, by fibrin such as the false membranes themselves are composed of, and seems to exhibit on a large scale an explanation of the small elevations on the false membranes above described. The cut veins as well as the sinus with which they communicate contained a quantity of loose brown fibrine. The pia-mater generally was vascular, but not otherwise affected. The cerebrum was firmer generally than it should be, and the convolutions were wider apart than usual, but posterior to the lateral convolutions the substance of the brain was much softened. The medullary parts of the brain were generally of a yellowish tint. The cerebellum was also indurated.

The other organs of the body were natural.

Microscopical appearance.— On examining portions of these false membranes they were found to consist mainly of firm fibrillated tissue almost entirely of a wavy character. This was the case as well in the thicker, stronger, and coarser layers, as in the delicate almost diaphanous layer. Along with this wavy fibrous tissue, numbers (in some parts very abundant indeed) of round and oval nucleus-like bodies existed, generally of the size of white blood corpuscles and in most cases nucleated, the nucleus being small and brightly refracting ; and here and there larger oval granular bodies were seen, numbers also of very small round and spindle, or oat-shaped cell-bodies, were met with at times. In places, but very rarely indeed, rather large blood-vessels with thin walls were seen, possessing but few nuclei in their parietes In places also numbers of variously-shaped coloured bodies were seen, evidently the remains of the colouring matter of the blood.

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* The preparation of the dura-mater and the false membranes, may be seen in St. George's Hospital Museum, as No. 2, a. Subseries vi, Series xxi.

Case 3.—*Acute Pericarditis with effusion.—Recovery with adhesion of the two surfaces of the Pericardium.—Absence of any Rheumatic affection.*

From the notes of Mr. C. H. ALLFREY, Cl., Cl.

PLATE VII.

Charles Rome, æt. 20, (vol. ii. p. 10), a single man, was admitted into King's College Hospital on January 20, 1860, under the care of Dr. Beale. He is an artilleryman, and was stationed until lately at Longford, in Ireland. His family are all healthy, and he himself has never had a day's illness since childhood, when he says he had brain fever. He has lived well and temperately; and is a well-nourished and muscular man, 5 ft. 8 in. in height, and 10 st. 3 lbs. in weight. States that he has never had rheumatism.

Present attack.—The patient was in excellent health till Wednesday, January 4th, on which day after two hours' riding with his regiment (at Longford), he began to feel very dull and tired and weak. The next day the weakness had very much increased. His breath was short and a cough came on, accompanied by running at the eyes and nose. He did not, however, expectorate much. He seems to have continued much the same for a day or two, but then he was unable to sleep and he applied for leave of absence and came home on January 10th. He was obliged to lay up, but yet did not improve. On January 19th he first noticed that his feet were swelled, and applied for admission into the hospital.

Present condition.—The patient is flushed about the face. He complains of great weakness, and can only walk about a little. His breath is very short, so that he can with great difficulty ascend stairs. Coughs a good deal. The expectoration is not so copious as it has been. His feet are a good deal swollen and pit on pressure; the superficial veins over the instep are very turgid. He does not complain of pains in the body or limbs, but admits that there is a slight pain in the chest. Appetite very bad; tongue furred in the middle. Bowels rather confined. Sleeps badly. The chest does not expand freely. There is dulness of the lower three-quarters of the right side of the chest behind, and bronchial breathing is heard over circumscribed spots, and especially at a small spot situated near the inferior angle of the scapula. There is rhonchus and crepitation over nearly the whole of the chest. The præcordial dulness is very much increased, extending upwards to the fourth rib; inwards to the right edge of the sternum, whilst towards the left it reaches to about an inch beyond the mammilla; no bruit can be detected, but the heart's action is very irregular and tumultuous. A rubbing sound is heard near the sternum. The pulse intermits very frequently and is very irregular, 112. R. 34.

There is no albumen in the urine. He was ordered to lie quite still, turpentine stupes were applied to the chest, and a linseed meal poultice over the region of the heart. He was put upon ammonia and chloric ether and half an ounce of brandy every three hours.

Four days after admission (twenty days after the commencement of his illness), the following note was made: The dulness now extends from the third rib downwards and reaches about an inch over the median line to the right. It extends on the left nearly to the middle of the side. Not the slightest impulse can be felt on pressing over the region of the heart firmly with the hand. Breathing can be heard as low as the sixth rib, and more or less distinctly all over the space described as dull. The sound elicited on percussion over the space is as dull as that produced by striking the thigh. A distinct rub can be heard from the fourth rib downwards as far as the cartilage of the seventh rib. It can be

heard an inch to the right of the middle line and at the lower part there is a distinct to and fro sound.   Behind, the breathing is coarse below the spine of the scapula (right), but not bronchial.   (Bronchial breathing was distinctly heard on the 21st, 22nd, 23rd.)   There is slight dulness over the right side, behind.   The pulse intermits almost completely every third beat.

After the above date the pulse fell to 90, the tongue began to clean, and the appetite to improve; the œdema of the legs disappeared; the dulness gradually diminished; and the rubbing sound became louder every day, and on the 28th was heard all over the dull space.   The patient now declared himself free from all distress; the pulse however was 106.   On February 4th (eleven days from the date at which the dulness was most extensive, and thirty-one days from the commencement of the attack), a marked diminution of the extent of the dulness occurred; the upper limit being between the fourth and fifth ribs, the right limit corresponding to the right edge of the sternum, and the left being slightly within the mammilla.   In the course of the two following days it had diminished to that size, which it has since permanently retained, being bounded to the right by the left edge of the sternum, above by the fifth rib, and to the left extending to about an inch internal to the mammilla.   The patient was then allowed to get up and appeared pretty well, but the pulse never fell below 100, and always intermitted, generally once every third beat.   The rubbing continued very distinct till February 8th, when it began to grow fainter.   The extent of the dulness on different days is seen by referring to plate vii, fig. 2, marks the second, and 3, the third rib; a, shows the limit of the dulness, from January 20th to February 3rd, when it was diminished; b, indicates the limit of dulness on February 4th, c, on the 6th.   The rubbing sound was heard at the points marked by dots in the space d, on the 24th, and over the entire space d on the 26th.

The patient was now convalescent, and was ordered to take three times a-day, Tr. ferri sesq. M.xx. in infusion of quassia.   A week afterwards (Febuary 15th), the patient was discharged.   The rubbing was scarcely audible; the pulse was 136 when he stood up, and very irregular.   He was found to weigh 8st. 11lbs., having before his illness weighed 10st. 3lbs.   The rubbing was still audible on February 21st.

Readmission.—The patient after he left the hospital, did not take proper care of himself.   He became ill again and was re-admitted on March 5th (two months after the commencement of the first illness, and three weeks after he left the hospital), with great distress of breathing.   His face was livid and bloated.   His legs and feet were swollen and pitted on pressure.   The heart's impulse was very feeble.   The dulness extended to its original limits (see plate.)   The pulse was very irregular, and so rapid that it could not be counted.

The breathing on the left side was very harsh, and the expiration prolonged, dependent probably upon a certain amount of compression of the lung produced by the distended pericardium.   For the next week he remained in much the same state; but the distress of breathing ceased the day after his re-admission.   A fortnight after re-admission, the dulness in the cardiac region had not perceptibly diminished in extent, and he was ordered to rub in mercurial ointment with opium.   In the course of a week after the commencement of this treatment, great improvement had taken place; the extent of the dulness gradually diminished, and the rubbing sound re-appeared, but the pulse remained weak and fluttering, varying from 100 to 120.   The respiration became hurried if he attempted to exert himself.   Adhesion of the surfaces of the pericardium was probably again taking place, and the fluid had been nearly all absorbed.   He was, therefore, again made an out-patient.

Clinical Remarks.*—It is very rare to meet with cases of acute pericarditis with effusion, occurring independently of rheumatic fever.   This man's attack appears to have originated

* Abstract from Dr. Beale's Clinical Lecture on the case.

in a cold from exposure, but throughout the whole course of the
malady there was no indication of rheumatic affection. All
the symptoms from which he suffered appear referable to the
heart affection. The amount of effusion in the pericardium
was very great, as indicated by the shading in the figure
(plate VII.). The œdema of the legs depended probably upon
an impediment to the return of blood to the heart, created by
the pressure exerted by the distended pericardium. The treat-
ment resorted to, consisted chiefly of counter-irritation by tur-
pentine stupes, linseed-meal poultices over the heart, ammonia
and chloric ether with a moderate quantity of brandy (two to
four ounces in twenty-four hours). Had the patient been very
restless, opium would have been given, and mercurial ointment
would have been rubbed in over the heart ; but as he was
carefully watched from day to day, it was evident that he
was progressing as satisfactorily as could be expected, and we
therefore thought it better to adhere to the treatment above
described, believing that the fluid would be gradually re-
absorbed, if the patient's strength and nutrition were properly
kept up. This man was under treatment less than four
weeks, and the whole of the fluid effused into the pericar-
dium, which at one time must have been very considerable,
was probably re-absorbed. The most favourable result which
could be hoped for, in such a case, the adhesion of the two
surfaces of the pericardium, certainly occurred. The man left
the hospital ; but about three weeks afterwards, in consequence,
probably, of want of care on the patient's part, the effusion
re-appeared and the pericardium was again distended to its
former size. The fluid was again absorbed under the influence
of mercurial inunction, and the patient left the hospital a
second time.

This man still remains under observation. He suffers from
great difficulty of breathing, his pulse is weak, very quick and
fluttering, and he is quite unable to work. He was discharged
from the army after the first attack.

Case 4.—*Chronic Bronchitis.—Emphysema.—Enlarged right
side of the Heart.—Anasarca.*

Reported by Mr. C. J. Workman, Cl., Cl.

Maria Dyke, aged 44, was admitted into King's College Hospital, under the
care of Dr. Beale, January 4th, 1860. She has been married twelve years, but has
never had any family ; has never had any severe illness, but five years ago first

became subject to winter cough. It seems that about two years and a-half since she had an attack of general dropsy, which commenced in her feet and from which she recovered perfectly in the course of five or six weeks.

Present condition, January 5.—The patient has a bloated appearance. The lips are of a dark colour. There is general dropsy, which commenced five or six weeks before her admission. At the present time there is distinct pitting on pressure over the sternum, and still more so over the back. She has a slight cough, but does not expectorate at all; there is some distress in breathing, but no orthopnœa.

The *chest* is large and barrel-shaped, and moves less than natural on violent inspiratory efforts.

On *percussion* there is dulness under the right clavicle *in front*, extending as low as the interval between the fourth and fifth rib. The rest of the chest on that side is resonant, and also on the other side. *Behind*, the right side is resonant; and on the left, there is resonant percussion below the angle of the scapula. Above this point there is some dulness.

On *auscultation*.—Rhonchus and sibilus are heard all over the chest *behind*, with occasional slight crepitation; the respiratory murmur is about *five* times the length of the inspiratory, and is accompanied by a cooing sound.

In front the breathing is bronchial on the right side beneath the clavicle, and is accompanied by moist crepitation, sometimes amounting to gurgling. This sound is heard as low as the dulness extends.* The expiratory murmur has the same character as behind. R. 28 per minute. The heart's sounds are feeble, and heard most distinctly in the scrobiculus cordis, they are both of the same length. The impulse is weak and felt in the scrobiculus cordis towards the left side. The cardiac dulness extends to about one inch on the right of the median line, and from the level of the nipple downwards to the scrobiculus cordis. It does not extend beyond the normal limits on the left side. The pulse is feeble.

The abdomen is tympanitic everywhere except over the liver, which appears to be somewhat enlarged, and reaches downwards to the umbilicus. *Urine* free from albumen.

Ordered turpentine stupes over the back and front of the chest, three times a day, and ammonia in decoction of senega, and half an ounce of wine every two hours.

She passed but little water and on the following day, half a drachm of spirits of nitre was added to each dose of the mixture. There being no diminution in the distress of breating, a mustard emetic was given which produced considerable relief for a short time. As she was becoming weaker, it was considered necessary to increase the quantity of stimulants, and half an ounce of brandy was ordered to be given every three hours. Compound spirits of juniper, compound decoction of broom and gin were subsequently tried, but no diuretic effect was produced. The anasarca increased rather than diminished; the distress of breathing was not relieved, although it did not rise in frequency to more than thirty until the day before she died. There was scarcely any expectoration. On the 10th the pulse which had previously been about 100 increased to 120, and a slight trace of albumen appeared in the urine. The patient's strength gradually failed and she died on the morning of the 11th, a week after admission.

POSTMORTEM.—Twenty-seven hours after death. Body well nourished, everywhere œdematous, face bloated, skin dusky, lips livid. Surface of the body generally pale, except the feet, on which are a few patches caused by congestion of the capillaries. Layer of adipose tissue over the abdominal wall, more than half an inch in thickness.

The left lung large, full of air, apparently emphysematous, nearly twice the volume of the right.

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* Dr. Beale remarked that the gurgling in this case probably depended upon dilated bronchial tubes, and the dulness upon some condensation of the lung.

The right lung appears small and hard, much harder than the left, much contracted in size; the *upper lobe* solid and firm; on making a section, it appears to contain but little healthy structure; numerous dilated bronchi were observed, but not to the extent often seen, some of them were nearly a quarter of an inch in diameter; the pulmonary tissue appeared as if it had been compressed, probably, at some considerable period before the present attack. The lower two lobes are crepitant but throughout, the bronchi appeared dilated. The posterior lower portion was a little congested, but this was probably post-mortem. The apex was firmly adherent to thorax.

The heart is rounded and somewhat enlarged, apex rounded and formed by the right ventricle. The right auricle and ventricle fully distended with perfectly black coagula; the walls of the right ventricle nearly half an inch in thickness.

The pulmonary artery admitted 2 fingers readily.

The inferior cava admitted 2 fingers readily.

The right auriculo-ventricular opening admitted 4 fingers.

The *tricuspid* valve thickened, especially towards the free margins, its surfaces somewhat roughened and puckered up.

The left ventricle contained clots of black blood, but was not distened. Walls of aorta perfectly healthy, considerable thickening and rigidity of the attached border of the semilunar valves, which in other parts seem healthy. Curtains of the *mitral* valve thickened and puckered up, much resembling those on the opposite side. The lining membrane of the left auricle thicker than usual, and easily peeled off. The heart, when empty, weighed 12¼ oz.

The *liver* reached down to the umbilicus; the gall bladder was very much distended with small gall stones, some of which were square. There were old adhesions between the gall bladder and great omentum, and adjacent parts of the liver. Liver everywhere hard, its capsule thickened and contained a perfectly white spot on left lobe. Tissue of liver pale with points of congestion, which were apparently caused by blood in the intra-lobular veins. Weighs 3 lbs. 2¾ oz. The other organs were examined and found healthy.

The two kidneys weighed 12¾ oz. The spleen 3½ oz.

*Clinical Remarks.**—This case afforded an excellent example of the changes which frequently result from chronic winter cough,—important alteration in the lung tissue, and, consequently impaired action of the organs. This was followed by engorgement of the right side of the heart, dilatation of the right cavities, leading to impeded circulation in the systemic veins, and general dropsy.

The diagnosis in the present case, was made easily and confidently. The bloated face, the blue hands, lips and feet, the extreme distress of breathing, clearly showed that the respiratory changes were not properly carried on, and that dark blood was circulating in the arteries and capillaries of the body as well as in the veins.

The large smooth barrel-shaped chest, with almost projecting intercostal spaces, the walls of which scarcely moved after the most violent inspiratory efforts; the prolonged expiratory murmur occupying five times the length of time required for forcible inspiration; the resonance on percussion; the rhonchus,

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* Abstract from Dr. Beale's observations on the case

sibilus, and cooing respiration, heard upon listening to the chest, clearly showed that the elasticity of the lung tissue was very much impaired. The distended pulsating external jugular veins, the increased dulness beyond the median line of the sternum, and the heart's impulse in the scrobiculus cordis, proved that regurgitation of blood took place at each systole, from the right ventricle through the dilated and unclosed auriculo-ventricular opening, and showed that the right cavities of the heart had suffered from the impediment to the circulation of the blood through the lungs. The two attacks of general dropsy but too clearly indicated, that the impediment to the pulmonary circulation was producing serious effects in all parts of the system, that the capillaries were dilated and gorged with dark blood, quite unfitted to supply nutriment to the tissues, and which failed to give off, through the different emunctories those products of decay, the retention of which in the system is incompatible with life.

A very interesting point in connection with the physical signs, was the presence of gurgling under the right clavicle, over a space where the percussion was dull. The general condition of the patient, her nutrition, and the history of her malady, induced the formation of a positive opinion, that the gurgling did not depend upon the existence of a cavity, while other considerations fully justified the conclusion, that there were in this region, dilated bronchial tubes containing secretion, and that the air passing through these produced the gurgling sound that was heard.

ON A SIMPLE AND ACCURATE METHOD OF RECORDING PHYSICAL SIGNS.

By Lionel Beale, M.B., F.R.S.

Fellow of the Royal College of Physicians.

PLATES VII AND VIII.

LATELY I have been in the habit of recording the exact situation of physical signs, by the aid of blank outlines of the chest, which can thus be filled up from day to day. Piorry has illustrated many of his published cases by illustrations of this kind. The plan about to be described is far more accurate and leads to more useful results, than can be obtained by describing the position and limit of the signs in words. There is, too, a great advantage in observing, as we can do by a glance

at the drawing, the seat of the dulness, crepitation, &c., instead of being compelled to read through a long description, which, however minute and careful it may be, cannot reach the same accurate precision as is afforded by a drawing. I have long advocated the importance of drawing microscopical appearances of objects, in preference to detailed descriptions, and believe that many of the same remarks will apply to the point under consideration. Whenever possible, we should substitute drawings for descriptions. It is only right that everyone earnestly desirous of being useful to his fellow labourers, should endeavour to increase the facility with which ideas may be made intelligible to others. In our profession, the engraver may be called in to relieve the printing press much more frequently than is now our habit, and I think that many branches of knowledge may often be more quickly, simply, and accurately expressed in drawings than in words.

In the hope of facilitating somewhat the plan of accurately recording physical signs, I have had three views taken of the male and female figure, engraved in outline (Plates VII, VIII).

The physical signs can be easily expressed in the small outline plans, by different varieties of pencil shading or by coloured chalk. I believe private practitioners will find these of great use, for although they cannot record long and minute descriptions of a case, they can, if furnished with such outlines, in half a minute transfer, with the aid of a pencil or pen, to one of these forms, the exact extent of dulness, &c., which they may observe. I have, therefore, had a number of these struck off, and they can be supplied at the cost of two shillings for fifty copies.*

In publishing cases in this Journal, the same forms will be used, and the shading, &c., will be indicated by printing from a wood block on the plates. See Plate VII.

In describing to a class the physical signs in a case, a large diagram in outline will be found very useful. The tints and lines may be drawn with charcoal, which can be very readily rubbed out.

There are many other means of facilitating the process of reporting medical cases, and of tabulating the results, which will be from time to time reported, and, I trust, that some of these will be found practically useful, and ere long carried out. We shall thus be enabled to increase the precision and accuracy of the diagnosis, and, at the same, time to use fewer words in expressing the results of our observations.

* 25 copies of the female, and 25 of the male outlines, are arranged together, and can be obtained by forwarding 24 postage stamps to the Editor.

ORIGINAL RESEARCHES IN PHYSIOLOGY AND PATHOLOGY.

ON CONNECTIVE TISSUE.

By S. Martyn, M.D., M.R.C.P.

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PLATE IX.

THE term " connective tissue," has not been much used as yet in England. It is the equivalent of " Bindegewebe," and has been adopted lately by those who have followed, in this country, the interesting observations of continental histologists; I say " followed," because there is no doubt that, for some years past, German workers have been the pioneers of this investigation. In 1858-59, for instance, about twenty authors made observations and advanced theories of importance with regard to this element, but it does not seem to have occupied the attention of English histologists, and of the above-mentioned number a very large majority were Germans. For want of better terms then, let " connective tissue " stand for " Bindegewebe," and " connective substances " for " Bindesubstanzen," a distinction necessarily retained for the present, but which, when our comprehension of the several included topics shall be more perfect, it is to be hoped we may be able to discard.

A twofold interest is attached to this subject. In the first place, by exact microscopic study of the elements in connective tissue, a large number of bodily textures have been recognized as related to each other, not merely in intimate arrangement, but also in their physiology and genesis, so that a great addition to morphology has been the result. In the second place, a very important application of the same study has been made to pathological phenomena. It not too much to say that " cellular pathology," with all its ramifications, is based on

and rooted in the doctrine of connective substance. It is difficult to forsee to what extent the views of Professor Virchow and his followers, will be accepted, now that his latest work is in the hands of English readers; but there can be no doubt that the condensed ideas, steadily pursued and developed through nineteen volumes of the Archives of Pathology, deserve the most impartial attention. In these allied tissues, of which we now purpose a review, it is, this school of pathologists assert, that morbid processes begin, in modes and localities, and travel through channels which are necessarily related, because truly homologous.

Without further preface, as the present object is simply to elucidate these structures, and show in how far they have a right to be thought related, I shall ask attention to some of the commonest connective tissues, with a view to determine their actual constitution; and, as an individual well-marked instance, will begin with a tendon. Now, simple as it seems, leading microscopists are not agreed as to this structure, and so, while fully aware that there are many difficulties to encounter, I shall have to lay before you the view adopted, after careful reconsideration, by myself.

Tendon is a specimen of dense connective (white fibrous) tissue, mixed with elastic (yellow fibrous) tissue, and requires examination by means of longitudinal and transverse sections (figs. 1, 2, 3). In a human tendo Achillis there are seen, in longitudinal sections; 1, cells; 2, fibres; 3, a substance which I shall call " extracellular."

As the *cells* are more difficult to understand in proportion as their age advances, I have figured them, in fig. 2, from the infant at birth. They are then fusiform, forked, or caudate, including a long, dark bordered nucleus, and are prolonged into fibres, which, when traced upwards or downwards, lead to other cells also including nuclei. These fusiform cells are arranged at pretty regular intervals throughout the tissue, and have a great tendency to sit closely to the large nuclei, and thus their presence is often marked only by the existence of a sort of triangular gap, above and below the nucleus. This arrangement might be represented by an oblong opaque mass, lying in a glass tube, which, when red hot, had been drawn out fine in each direction. In the adult tendon some of the cells have become still more closely attached to their nuclei, and their prolongations are so very fine as to escape notice readily, while in others a metamorphosis into fibres has taken place.

Secondly, we see *fibres*; in part proceeding from, and in part meandering between the cells. These fibres are the elastic

tissue in a very rudimentary condition, and we recur to them afterwards in a tissue which presents them more developed. Here it is, however, that we may see their origin and watch their growth. The finely drawn-out cell just described, may have become thicker, more drawn out, and long enough to extend across the entire field of the microscope, as a fibre of elastic tissue. On the other hand, the whole section will be found to present fine fibres, as is also the case even in the adult tendon, arising from the cells, and consisting of the drawn out cell walls. To see these in adult tendon we may proceed as follows: a very thin section of the half dried tendon is to be freed from fat, by dipping several times into ether, and instantly pressing it between folds of blotting paper. Having expanded freely to its original width in water containing glycerine, it must be placed under a power of 300 diams. Selecting a favourable edge of the section, a drop of dilute nitric acid (20 p. c.) is allowed to penetrate; the whole becomes rapidly pale, and the cells may be distinctly seen to have fine fibres attached to their points. Here and there a nucleus will shrivel and curl up, so as to become apparently or even really detached from its processes. These fibres are very fine, they often require the smallest amount of light to be seen, and it is not easy to measure their thickness when accidentally isolated; I have often found it to be less than $\frac{1}{40000}$ of an inch. Acetic acid renders them invisible, leaving the elastic fibres of a higher development unaffected, so that the cells seem to be merely nuclei, and the fibres to have no relation to them; the truth being that the coarse fibre is never attached, in adult tendon, to cells retaining their typical form, while the true fine fibres, which are attached to such cells, have disappeared.

Thirdly, there is between the cells and fibres, a *substance* for which we shall afterwards find the right name to be " extracellular." This is a grey, longitudinally striated mass, which may be torn into smaller and smaller bundles but not into ultimate fibrils.

In transverse sections (Fig. 1) all the three elements are distinct, but another appearance is now added, to which great importance has been attached. Each cell has several processes radiating from it, and, especially in young specimens, there is a clear anastomosis between the cavities in the radii of adjacent stars. It was in studying the mode by which nutritive matters travel through ultravascular textures that Virchow observed these stellate bodies to resemble very strikingly the lacunæ and canaliculi of bone, and he therefore concluded that these struc-

tures were similarly arranged for what he called an "intermediate juice channel system." In this view he is followed by Kölliker, who decides on the name "plasm" cells as applicable to all the cellular constituents of connective tissue. On the other side, Henle not only explains away the stellate forms, but, failing to find any fibres at all attached to the cells, declares these to be "vestiges of fœtal organs,—destined at most to preserve interstices." Now, if the views above advanced are correct, it is evident that each of these great opposing statements contains an admixture of error and truth. Virchow is right as to the existence of processes from the cells, for there are such in the longitudinal direction, and right, of course, as to the existence and anastomosis of stellate cavities (Plate IX., Fig. 1). That these, however, are not processes from the cells is equally certain. They are frequently seen without either a cell or fibre in the centre; they retain their forms, as was shown by Henle, if the preparation be viewed from the other side; they disappear under the influence of acids (Fig. 3.); and they are not seen in a longitudinal section. All these effects are incompatible with the idea of them as processes, especially the last; for were such their true nature it is certain they would be seen, in the longitudinal section, to occupy a transverse direction; and this is not the case. There is no other possible explanation of their absence than that they are planes, which, in the longitudinal section, cannot obstruct light enough to be seen, doing so however when cut across. They must, therefore, be true interstitial spaces formed by the junction of two, three, or more bundles of the extracellular substance, and at such junctions the cells are frequently situated. On the other hand the idea of Henle that cells in connective tissue are, like sundry other vestiges of fœtal organs, obsolete, is a far too transcendental morphology: it is much more probable that these, and similar bodies elsewhere, deserve the name long ago bestowed on them by Goodsir—"centres of nutrition" or "germinal spots." From the observations of cellular pathologists we may confirm this proposition, for it is either in or near the "permanent nuclei" of tissues that diseased processes begin. I say in or near, because, having been hitherto unable to see the first step of a new formation like pus, tubercle, or cancer, as actually consisting in a division of original nuclei, it seems to me that this point should be reserved. Besides, having shown the stellate structure of connective tissue to be not a cell but an interfascicular cavity and not even a cavity until opened out by manipulation, it follows

that, should it be found infarcted with heterologous material, this may be truly extracellular, though in the neighbourhood of, and somehow originating in, the nucleus.

We have now reviewed the structure of *dense* connective tissue as it appears in a tendon, which is a mass of well-nourished tissue combining great pliancy with tenacity, and which, with a perfect capability of repair, yet subserves a purpose of the mechanically passive kind. Besides tendons and ligaments, we find the dense connective constituting fibrous tunics enveloping bones, muscles, nerves, brain, glands, and in fact most organs; the lower layers of serous and mucous membranes, as well as of true skin; the coats of all vessels in part; and, mixed with another element, the so called fibro-cartilages.

There is again a form of connective tissue the characters of which are looseness and softness of texture, and which occurs throughout the organism as a means of uniting and isolating various parts. It unites the skin to subjacent organs; it forms an outer sheath for any vessel, nerve, or muscle-fibre, between which and other parts free movement has to take place; it often becomes fatty tissue and so forms a padding and packing for the organs. In all these various forms the three constituents on which we have insisted are nearly if not quite constant. The tenacity and elasticity vary according to the requirements of each case, being in proportion to the development of the elastic element, and the cohesion between the bundles of extracellular substance. An examination of the loose variety of connective is by no means so easy as is apt to be imagined. In the case of a fragment of the delicate web separating the fascicles of muscle we are familar with what used to be called cellular, and is now generally termed "areolar" tissue; *i.e.*, striated, wavy bands, with occasional corpuscles and elastic fibres, which become very distinct under the influence of acetic acid (Todd and Bowman, I., 74). With regard to each of these elements questions arise, some of which I have already attempted to answer. The elastic element is, in this case, much more developed than in tendon, and was formerly called "yellow fibrous," a name which, as it is neither yellow nor fibrous of necessity, may be abandoned; while, as it seems always to confer elasticity, a name thence derived may be provisionally retained. The "elastic" fibres then are distinguished in this case by their curled, wavy course, yellowish colour, and tendency to subdivision. They never arise from cells in the adult, but a portion of their length may often be found to present a wide, flattened and fusiform appearance; it is sufficiently established that they arise from the

" nuclear fibres," or delicate cells and processes existing at an early period. According as elasticity is required, so do these very fine cell processes undergo a change into the thickened, yellowish, flattened, and branched condition, in which they have absorbed the cell from which they were derived, and entirely altered their chemical constitution ; for whereas in the fine and thin state they are soluble in acetic acid, when developed into true elastic tissue they resist all reagents except in so concentrated a form as to frustrate any further analysis. Repeated observations, with a power of 1000 diameters, have convinced me that the fine fibres are both finer and more extensively distributed than we are generally given to suppose. Loose connective tissue is everywhere pervaded by them, and that they arise from the cells scattered throughout it is highly probable. The true relations of fine fibres were indicated by Todd and Bowman (I., 74 and 75), but a satisfactory demonstration has not yet been made, on account of the great difficulties attending even the most careful manipulation. In every well-arranged specimen isolated cells may be found in open spaces between the wavy bundles, and, if the light be properly moderated, a series of fine fibres may almost always be found to radiate from each cell in several directions. Some, but not all of these, may result from accidental entanglement, and I feel convinced that the origin of the fibre from the cell closely surrounding its nucleus, is the correct interpretation of this appearance.

To turn now to the development of these various components of connective tissue ; it has seemed to me, in regarding the above mentioned and other similar fibres as processes from cells, that the whole theory of " cell processes " required revision. Elastic tissue at an early period, say at birth, occurs as fusiform nucleated cells arranged in a linear series and united by irregular and often pointed processes. The mind recalls early stages as well as later conditions of all cell networks: thus, stellate pigment, bone, nerve, lymphatic, and capillary structures, may be adduced as instances of what is usually understood to be the result of cells sending out prolongations or processes which meet and coalesce so as to become a network of tubes. To discuss this important question would lead me far beyond the limits of the present paper, and I will at present simply ask these questions :—Are we sure that we know how these pictures were brought about? Do we know that one of these cells independently sends out a pointed process? Must a nucleated tube be formed by cells which have arranged themselves in rows, and coalesced by absorbtion of partitions? My own belief is entirely opposed to the received idea. To me a

fine and impermeable (or nearly) young capillary is no more a process from a cell than the thread made by the receding twine spinner is a *process* from his bundle, and which is rather left behind by his moving away. So cells, already as embryonic structures, undergo division into several individuals, but the constrictions at the points of division may become elongated by removal of the nuclei-holding centres from one another. As one nuclear centre recedes from another the cell is, so to speak, ligatured; but, though this proceed to a virtual cell division, delicate fibres, overlooked usually by the microscopist, continue to unite the members of the new brood. These while serving as guiding threads for subsequent formations, would, in one case, become hardened into solid elastic bands, and, in another, dilated and modified into a capillary, or process of a multipolar nerve cell. The blood cells of the embryo chick actually pass through a stage in which they are for the time united only by a stretched thread. When, however, after cell division in the longitudinal way, the cell contents become highly modified and increased, the act of ligature is prevented and a long tubular cell results, like the striated muscular fibre; the nuclei in its sarcolemma indicating an origin from one cell which divided *quoad* its primary nucleus but not cellwall. I cannot deny the possible coalesence of a linear series of cells by absorbtion, but should demand very much stronger evidence for any particular case than is usually at hand. The important indication of these views is primarily that certain forms assumed by tissues are not formative acts of the cell-wall, but the results of mechanical action exercised upon it from within or from without. In the case of connective tissue we have next to ask, how, on the above principle, do the fibres of elastic tissue arise?—how are they spun?

This leads directly to the development of the remaining element, the pale, striated, and wavy bands. Since the scheme propounded by Schwann that, at an early stage, connective tissue consisted of fusiform nucleated cells, becoming fibrous and splitting at their ends, the most distinguished theories have varied as follows. According to Henle, there was first a blastema, becoming ultimately fibrous, and in which nuclei existed; these sent out processes which united to form "nuclear fibres." Reichert placed as the first step the existence of cells, between which an intercellular substance was deposited, a substance which never became truly fibrous, and had never consisted of fusiform cells, as stated by Schwann; with this, then, the original cells blended, and nuclear spots remained behind. Virchow, however, first clearly enunciated that, though the

intercellular substance is not a modification of what was the formative cell, still that there is a cell present, and permanent too as such, and not merely as a nucleus; and that this cell sends out processes forming the various stellate and fusiform figures which we have already discussed. Each of these, and, indeed, many other observations and inferences made by recent writers, as Luschka, Beneke, H. Müller, and Billroth, contain valuable portions of the truth; and although Virchow has elaborated so complete a theory as to have received the adhesion of Kölliker, it will be observed that, if the view we have endeavoured to maintain is the right one, considerable alterations must be made in the most advanced conception of the early and late morphology of connective and elastic tissue.

I hold that at the earliest period what is to become connective tissue consists of embryonic cells, in contact with each other; and that the next change is a division, in longitudinal directions, of the nucleus; at the same time a deposit takes place on the outside, and probably only on *one* (the nuclear?) side of the dividing cell. This is the extracellular substance, the outer, or secondary cell-wall, corresponding to the cellulose wall of vegetable cells. This deposit is made in layers, and is striated accordingly; extending then, chiefly in a longitudinal direction, it carries with it the nucleated centres of its generating cell. Thus do these centres become separated from each other, and the intermediate cell is reduced to a delicate thread. Some of these cell networks become transformed into thicker and stronger bands, and so on ultimately into elastic tissue; others remain, elasticity not being much required, in their primitive state. If, at the first appearance of extracellular deposit, the tissue be torn up for examination, the "matrix" will separate into longitudinal fibrous-looking masses, more or less fusiform, and each having its generating cell attached. This is the scheme which Schwann figured, and to which Kölliker, accedes to the extent of the cellular nature of the fusiform masses. But, from every point of view, even the drawings of Schwann themselves, I am led to believe that there is no including membrane, and that these must be considered as true fragments, although genetic unities, of what I have called "extracellular" deposit. As the metamorphosis proceeds the long wavy bands result, in various directions between and around which wander the elastic fibres at very acute angles; so that, if any one bundle be expanded violently by acetic acid, the well-known spiral constrictions are produced by what have then become nearly transverse ligatures. Much unnecessary confusion has been introduced in explaining this simple phenomenon, a very elaborate disquisition of which,

by Dr. Klopsch, may be found in Müller's Archives for 1857 (p. 417–435). His conclusions do not stand the test of further investigation. We have already seen Virchow's and Kölliker's view to be that the cell-processes form a system of channels for nutritive fluids (plasm cells). Now, as I have already shown the stellate forms to be interfascicular, it remains to inquire whether the elastic fibres can be tubes for the above purpose. Virchow believes that they are so (Cell. Path. p. 94); and, indeed, some of the most important propositions of cellular pathology hinge on this idea of a permeable cell network in connective substances. But, though all prolongations of cells must be conceived of as hollow at first, I have been unable to convince myself that the elastic fibre retains that character; in fact, very thin sections of tendon, moistened with glycerine, and viewed with high powers, show the cut ends of the fibres with no trace of a central canal, or point of a medullary kind. It seems to me rather rash to assume the persistence of a tubular character in fibres of the finest kind when we cannot demonstrate it in coarser ones. The only approach to a proof of such a structure is that in injections of cornea and tendon with indigo, made by Wittich, the blue particles were found to have permeated the fusiform elements of a longitudinal section; but it should be remembered that if there be a space between the bundles, in which the cells and fibres lie, the colouring matter must accumulate in contact with them; in fact, the investigation requires confirmation with extraordinary care before we can give our adhesion to any conclusions. There is no *a priori* reason for seeking a system of nutritive canals in the tissue under consideration; certainly no more than in cartilage, where we know that nutritive matter must pass through the intervening solid substance from blood-vessel to cell, or from cell to cell.

It was in 1845 that Reichert ventured on the generalization which has proved of such great histological interest. He classed together with "connective" those tissues which are nearly related to it in character; and thus "connective substance" has come to be reckoned as one of the great primary orders of structures. If we divide all tissues into four groups, 1, Cell Substances; 2, Muscle Substances; 3, Nerve Substances; 4, Connective Substances; we find that there is a truth underlying this classification, and justifying at all events its temporary adoption.

The fourth group includes, by pretty general consent, the vitreous humour; *mucous tissue*, one which occurs in lower animals and certain gelatinous tissues of the embryo, but in one

adult structure only, namely, *cartilage; connective tissue*, including the elastic element; and *bone*, including teeth. According to Kölliker, the differences between these structures are so great, that they are united only by corresponding function, in as far as they all either support or connect various parts of the body ; and by allied genesis, for they all are more or less, at early or late periods, convertible one into another.   There is, nevertheless, a true morphological relation between these tissues, for they all consist of cells more or less branched in character, and having a substance outside them, the order in which I have placed them above according with the progressive degrees in which branching and anastomosis ascend.   Chemically, too, all these substances are allied in yielding either gelatine, or, what is very similar, chondrine.   Although it is to the genius of Reichert that we owe the theory of the connective group, it must not be supposed that the scheme was laid down at once in its present extensive application.   Reichert's paper had remained for five years without much other notice than contradiction, when an important move was made by certain demonstrations of Virchow, Kölliker, and Sharpey, who showed that, pathologically and normally, bone is developed from connective tissue ; and that the latter, when about to ossify, often assumes the character of cartilage.   Almost at the same time (1851–52) Donders, Henle, Remak, and others, described the " nuclear fibres," their attachment to cells or nuclei, and their possible development into elastic tissue.   The excellent compendium of the present state of this subject lately given in Kölliker's work renders further historical notice less necessary, and indeed it would be foreign to the object of this paper.   I purpose rather to show that the difficulties still felt as to the homologies and metamorphic development of connective elements may have some light thrown upon them by what has been stated.

A synopsis of existing theories, drawn up last year by Kölliker, may be condensed as follows :—1, Remak : The basis of connective substance is developed out of an outer secondary membrane of the cell, and there is no intercellular substance at all.   2, Reichert : Basis of cartilage intercellular, of connective developed out of roundish long cells and a substance between them, blending.   3, Kölliker and Sharpey : Basis of cartilage and mucous tissue mostly intercellular, but partly formed of an outer cell-wall : it is in connective tissue, formed by melting together of cells, along with which, in certain cases, there is an intercellular substance.   4, Donders and Virchow : Basis intercellular, not developed out of cells.

There appear, at first sight, to be hopeless differences

between these formulæ; but the more we think them out and collate them with the facts, the more they blend, ceasing at length to be antagonistic. The extreme views of Remak and Virchow may be shown actually to meet; while, in the case of the other two, the separation of cartilage as to its constitution from the other members of the connective group is the most prominent point of difficulty; and this I believe to be unjustifiable, and productive of much confusion.

In attempting to prove this, it is necessary to make a comparison of cartilage, both in its complete and early state, with a vegetable tissue on one side and connective tissue on the other. In vegetable no less than in animal tissues, the so-called "intercellular matter" has furnished a vexed question; and as those who advocate the existence of such a structure have asserted its presence to be indisputable in the frond of "Porphyra," I have given a drawing from this very seaweed to show how, with ordinary care, the debated structure may be explained. Each cell (Fig. 4) is a clearly-defined, dark, primordial utricle, immediately around which is its celulose wall; but between one cellulose wall and another is a variable space (intercellular) which is, however, resolvable by moderated transmission of light into several layers, the true origin of which is apparent enough. Growth has here proceeded by cell-division; the nucleus and primordial utricle having divided, each half becomes surrounded by a new cellulose cell-wall, *included* in the dilated older one; and, as this goes on, the old cell-walls become more and more numerous around any particular group in proportion to the number of its elements. Modified by age, and pressed into angles by newly encroaching groups, these layers at length resemble a true "intercellular" substance, as the rough plan in Fig. 6 may help to explain.

I suppose no histologist would deny the analogy between vegetable structure and that of cartilage when presenting a capsular arrangement, or during its early stages. (See Virch. Cell. Path., Figs. 1, 2.) The formation of cartilage is a familiar anatomical object; substitute for primordial utricle, cartilage cell, for cellulose wall, cartilage capsule, and the above description of vegetable growth applies in almost every particular to that of cartilage. Even in far advanced stages of cartilage growth, as in the cricoid of a lamb (Fig. 5), a structure is seen, to which all I have said of Porphyra equally applies, and in which there is no trace of any intercellular, or as it must here be called intercapsular, substance. Whether the lines or laminations become obliterated or no, the facts of development were

similar; and it seems impossible to doubt, where a wide hyaline
space occurs between cartilage capsules, that this so-called
matrix was built up in the same way, and that it therefore con-
sists of old, dilated and blended capsules. Apply now this
analogy, which we find between cartilage and a vegetable
tissue, to connective tissue itself. The cell of connective tissue,
with its great power of resisting chemical reagents, and its
tendency to become modified by splitting into elastic fibres, is
the analogon of the cartilage cell. They possess similar quali-
ties, seem to be allied in composition, and, in fact, at any
point where connective tissue is affixed to embryonic cartilage,
a gradual transition may be easily seen from connective tissue
cells to cartilage cells. Near such a junction the cartilage cell
becomes elongated, generally at one end, so as to present a long
sharp point, often wavy, and bearing too close a resemblance to
elastic fibre cells to allow of doubt as to their being homologous.
But in cartilage there is the capsule or chondrine yielding
deposit without the cell-wall; while in connective tissue this
must be represented by the "intercellular" part the gelatine
yielding matrix. It would be easy to show many points of
similarity between the extracellular deposit of connective and
the extracellular deposit of cartilage; but perhaps enough has
been said to explain the above-mentioned four theories. If
extracellular deposit be synonymous with outer cell-wall, or
accumulated outer cell-walls, as I have endeavoured to show,
the views of Remak and Virchow are to be understood as
follows: the one states that no intercellular substance exists in
connective, the other, that all between those defined elements,
the commonly called "nuclei of fibrous tissue" is intercellular.
Its non-existence means that all you see is cell-wall of some
sort, though it be *outer* cell-wall, the "nuclei" being by rights
elevated to the rank of cells. That there is nothing in the matrix
but intercellular substance (Virchow) is to say that, even if con-
nected with, and a deposit from, cells, it is not the cell-wall;
not the primordial, but only a secondary structure. Both these
statements being tenable, I should regard any contention
between their adherents to be one of terms. Reichert insists
on a true intercellular substance in cartilage; but this we have
already seen to consist, like that of Porphyra, of former cap-
sules, while it is the latest capsule which differs in its interesting
and not yet investigated structural arrangement from former
ones, or the erroneously so-called mother-cells in contact with it.
Kölliker refuses to allow the complete parallelism of connective
substances chiefly for the three following reasons. In mucous
tissue there is a distinct structureless intercellular substance;

an argument of no great importance, even if the cell network of this gelatinous tissue becomes fibrous at last, for the capsule of cartilage is often laminated while the matrix without it is structureless and may even be semi-fluid. Secondly, because there are in connective tissue true corpuscles having no connection with elastic elemental cells—a point which, I think, is answered by the almost invariable attachment of extremely fine fibres to connective cells indiscriminately. Lastly, his belief in formative cells of the basis of connective (in the sense of Schwann) involves another difference from cartilage, which vanishes at once if the fusiform bodies be viewed as extracellular fragments, in the way explained above.

In conclusion, I would protest against the attachment of undue value or reverence to this classification of particular tissues as one group. The points which connective substances have in common, though exclusive, are not very numerous ; and nothing can be more useless than to arrange amongst them all tissues which are formed from stellate or fusiform modifications of embryonic cells, as, for instance, the capillaries and terminal nerve plexuses. Indeed, were not the apostles of the connective theory, as for example Leydig, so serious in pressing tissues into their favourite ranks, we might have suspected them of an attempt, by an undermining irony, to destroy the whole systematic fabric.

The parts of which an embryonic nucleated cell is composed meet with various fates, according to the demanded function. If the reproductive act is especially required, or metamorphic power to be retained, the nucleus is the chief agent. Vegetative functions of nutrition and rejection are performed by the cell-walls, or by tissues developed out of cell-walls. The animal functions, or those of muscle and nerve, are executed by the modified contents of cells. But if the mechanical function of elasticity is in request, this quality in the cell-wall becomes exaggerated to the loss of other qualities ; while, if mere passive resistance is to be exercised, a deposit takes place for the purpose *outside* the cell, whose remaining powers then sink, more or less, into abeyance. In the two last cases, the embryonic cell has originated what may be distinctively termed a "connective substance."

REPORTS OF RESEARCHES PUBLISHED ELSEWHERE.

ON CELLULAR PATHOLOGY.

Report by A. B. Duffin, M.D.

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THE appearance of another edition of Professor Virchow's interesting work induces us to attempt a more extended analysis of some of his opinions than has, as yet, been issued to the profession.

The views advocated are so original, so comprehensive, and so imperfectly known or understood in this country that, although many commentaries upon them may be already extant, we feel an impartial review of the chief pathological modifications that are urged in the volume before us to be still called for. In his introductory lecture Virchow recognises the claim of the cell to be considered as the ultimate form-element of all vital phenomena; and he asserts, that all activity must be regarded as emanating from the elements of the tissue as such. The living element can, however, only be considered as active so long as it represents a unity. After a comparison of the animal with the vegetable cell, which induces him to consider the cell membrane as the equivalent of the primordial utricle, he assigns to the nucleus the office of preserving and of multiplying the elements as living parts, whilst he refers the function of the part to the cell contents. The cell, as a whole, is assumed to exercise a certain power beyond its own boundaries, so as to regulate the life of a given amount of the interstitial material that surrounds it. This latter may be so small in quantity that the individual cells may be regarded practically as apposed, or it may so increase as to separate them considerably, or in a third variety of tissue a reticular arrangement of stellate elements may sustain cell continuity whilst admitting the presence of a large amount of interstitial material. But in every case each cell pursues its own path, and experiences its specific changes without necessarily involving the fate of its

neighbours. Each cell has its own territory, and the whole animal represents the sum of such vital entities. The theories of free cell formation advocated by Schleiden and Schwann are then analysed and rejected, and the principle is laid down that no development begins, *de novo*, but that equivocal generation must be as decidedly rejected in the history of the development of the individual parts as in that of entire organisms. " Wherever a cell originates, there a cell must have gone before; *omnis cellula ē cellulá*, just as an animal can only originate from an animal, a plant from a plant ; a constant law of continuous development exists."

Upon this general hypothesis Virchow proceeds to found his broadest classification of tissues.

" There is one point of view whence all normal tissues may easily be grouped into three categories.

" Either you have tissues that consist exclusively of cells, where cell is apposed to cell, in the modern acceptation, cell-tissue. Or you find tissues where each cell is regularly separated from its neighbour by a certain interstitial mass, (the intercellular substance) in which consequently, a kind of binding material exists, visibly uniting the cells to each other, but simultaneously keeping them asunder. To this division belong those tissues that are usually comprehended under the denomination of tissues of the connective substance (Bindegewebe), and among which what was formerly understood as cellular tissue plays the most important part. Finally you have a third group of tissues in which specific developments of cells have taken place, so that a peculiar arrangement has been obtained, an arrangement in part so peculiar, as to apply exclusively to the animal economy. These tissues more especially characterise the animal, although a few of them present transitions to the vegetable forms. Hither belong the muscular and nervous systems, the vessels and the blood."

" The second of these histological groups is delineated in so original a manner that we here venture to quote largely, more especially as a great number of German pathologists esteem it one of the most important agents in pathological processes."

" Formerly, connective tissue (Bindegewebe) was almost universally held to be essentially composed of fibres. If loose connective tissue from different regions be examined, *e.g.*, subcutaneous areolar tissue, pia-mater, submucous or subserous cell tissue, loose bundles of fibres will be found (like locks of hair) the lock connective tissue. This appearance of locks which recurs at certain intervals, so that a variety of fasciculi are produced, was the more positively referred to the existence

of individual fibres, as in fact isolated threads are often seen to project from the ends of the bundles. Nevertheless a most important attack was some ten years ago directed against this theory. Reichert endeavoured to demonstrate that these fibres were merely the optical expression of folds, and that connective tissue everywhere formed a homogeneous mass possessing a great tendency to the formation of folds."

" Schwann assumed that spindle-shaped cellular elements existed primarily, the famous *tailed bodies* (fibro-plastic bodies of Lebert) and that from them fasciculi of connective tissue were derived, the body of the cell splitting up into individual fibres, whilst the nucleus remained unchanged. Henlé, on the other hand, inferred from the development that no cells were originally present at all, but that nuclei were formed in the blastema at regular intervals; the fibres of a later period originated in the direct cleavage of the blastema itself. Whilst the interstitial mass was thus differentiating itself to fibres, he assumed that the nuclei gradually lengthened, so as at last to come in contact, and give rise to those peculiar long fibres, the nuclei fibres. In opposition to these views Reichert has made a most important advance. He proved that an enormous multitude of cells, separated by a certain amount of intercellular mass, was alone originally present. He believed, however, that at a given period the cell membrane and the intercellular mass became fused, and that a stage supervened, analogous to that described by Henlé, when the boundary between the old cell and the interstitial mass ceased to exist. Finally, he presumed that the nuclei in some forms entirely vanished, but that they were retained in others. On the other hand, Reichert strenuously denied the existence of Schwann's spindle-shaped elements. He regarded all spindle-shaped, tailed or angular elements as artificial productions, just as the fibres in the interstitial mass were a false deduction from an optical picture."

" My own investigations have taught me that the observations as well of Schwann as of Reichert are valid to a certain extent. Firstly, against Reichert, that true stellate and spindle-shaped elements undoubtedly exist, but then against Schwann and with Reichert, that a direct cleavage of the cells to fibres does not take place, but rather, that what is subsequently recognised as connective tissue occupies the situation of the previous homogeneous intercellular substance; I found, further, that Reichert as well as Henlé and Schwann were wrong, when they finally only left nuclei or nuclei-fibres; that on the contrary, the cells themselves were retained. The connective tissue of a later period is in no wise differentiated from the connective tissue of

an earlier date, either in general structure or in disposition. There is not an embryonic connective tissue with spindles and a developed one without them, but the elements remain the same, although they may be sometimes difficult to follow. In everything essential this entire group of low tissues can be reduced to a simple plan. As a rule the greater part of the tissue is composed of intercellular substance in which cells are imbedded at certain intervals, and these may have the most various forms. But the tissues cannot be so distinguished that the one only contains round cells, the other only tailed or stellate cells, but rounded, long or angular elements may be detected in all the tissues of the connective series."

Virchow illustrates this latter remark by a reference to articular cartilage. He finds the cartilage cells to become spindle-shaped with some fibrillation of the intercellular substance, so as greatly to resemble connective tissue close to the surface of the joint. If traced away from the joint they become star-shaped, and gradually pass into connective tissue. Adipose tissue he also identifies with the connective series, as he supposes the corpuscles simply to become filled with fat. But a number of other formations are also classed with this group. Thus, it is argued, that the lacunæ of bone represent the corpuscles of connective tissue, whilst the canaliculi correspond to their tails. " I have endeavoured in various ways to prove that these (lacunæ) are really small bodies, and not simple cavities in a dense fundamental tissue; that they represent formations with special walls and proper boundaries, which can be separated from the interstitial substance," p. 75.

A great development is given to the physiological value of these cells and tails. They are asserted to have a special relation to nutrition; to imbibe various nutrient matters and to transmit them variously modified to the tissues. They are thus made complementary to the ordinary vascular system.

" The distance between two osteal vessels is often very considerable. Whole systems of lamellæ intervene between the medullary canals, and they are traversed by numerous osteal bodies. It is certainly hard to imagine the nutrition of such a complicated apparatus as being solely dependent upon the activity of a distant vessel, and especially to represent to oneself in what relation each separate particle of this great compound may stand, as regards its nutrition to the vessel. Now, experience teaches us, that in point of fact, each osteal body possesses its own nutrient relations." The district supplied by a vessel is then described as a vascular unity, and he continues " Closely examined, even this vascular unity still

appears as a complex; it does not suffice to divide the body to
vascular unities, but the cell territories must also be respected.
From this point of view I consider the proof of the existence
of a special system of anastomosing elements in connective
tissue as of peculiar importance," p. 76.

This last observation is also applied to dental tissue, the
dental canals and spaces between the columns of the enamel being
taken to represent the processes of the star-shaped elements.
The same relation is also pointed out as existing in fibro-car-
tilage.   Of the semilunar cartilages of the knee-joint, he says:

" These latter are still generally described as cartilage, but
yield gelatin on boiling and no chondrin.   Still in this hard
tissue we find, just as in the cornea and in fibro-cartilage, the
same system of anastomosing elements, only developed with
unusual sharpness.   Vessels are almost entirely absent, but we
have a corneal system of unusual beauty," p. 80.   Numerous
other examples are given, but none perhaps are so striking as
that of the umbilical cord.   He describes the gelatin of
Wharton, as structurally identical with connective tissue, the
gelatinous part representing the expressible portion of the
intercellular substance.

" The proper mass of the umbilical cord, consists of a
reticulate tissue, the interspaces of which contain mucin and a
few round cells, the supports of which are a fibrous substance.
Within this latter lie stellate elements.   If by treatment with
acetic acid a good preparation be obtained, a regular network of
cells will appear; this separates the mass into regular divisions,
so as to render possible a uniform distribution of the nutrient
material throughout the whole."

The structure of the gelatin of Wharton, coupled with that
of the chorion and of the vitreous humour, all of which yield
mucin, induces our author to establish a parallel between
the " mucin" yielding, and the connective tissues.   The former
he regards as the unripe equivalent of the latter, although the
transition does not necessarily occur.   The mucous tissue may
persist through life, as in the vitreous humor, or in states of
general emaciation, the fatty may actually retrogress to mucous
tissues.   (Archiv. v. 14, p. 16.)

The conclusions to which Virchow would have us arrive
respecting the structure of the whole group may be summed up
as follows : (Ibid. p. 9.)

1. " Connective tissue early consists of closely packed cells
between which a homogeneous interstitial substance appears.

2. This substance remains homogeneous or becomes
fibrous.

3. The originally round cells may persist as such or become spindle or star-shaped.

4. The spindle or star-shaped cells unite, (Bindewebe-körporchen.)

5. Part of the cells is modified into elastic fibres, part receives pigment, another part fat.

6. The larger number of the cells is retained in a somewhat shrivelled shape and constitutes a permanent regulating apparatus for the nutrition, the interchange of material, and the new formation of connective tissue."

Such being a rapid sketch of the main views entertained by Virchow, our readers will doubtless be curious, to know to what extent they are corroborated by other observers, and particularly how they have been received in the land of their birth. Kölliker is prepared to assent to a large portion of them, but he can only give a modified confirmation to the developmental history of connective tissue. " In connective tissue they (the cells) become transformed essentially according to two types, and are converted, firstly into connective tissue corpuscles, and secondly, into the proper cells of connective tissue, the latter of which pass into the fibrous matrix of the tissue, whilst the others persist as cells, or are converted into elastic fibres." (Manual of Human Microscopic Anatomy, p. 41, 1860.)

Leydig also gives a hesitating assent. They are on the other hand vigorously defended by C. O. Weber (Virchow's Archiv. vols. xiii.—xv.) ; by Friedreich (Virchow's Archiv. vol. xv.) ; by His (Beiträge zur normelen in Pathol. Histol. d. Cornea) ; by Donders, who described the corpuscles almost simultaneously with Virchow (Siebold und Kölliker's Zeit-schrift, vol. iii.) ; by Wittich, who says that he has injected the processes of the cells with chromic acid (Archiv. vol. ix.) ; by Böttcher, who says he has injected them with carmine (Archiv. vol. xiii.) ; by Billroth, who admits all but the tubular nature of the processes (Beiträge Pathol. Histol. 1858), etc.

As we have seen they are more or less inconsistent with the views of Schwann, Reichert, and Henlé, and very recently Baur has had reason to believe that the stellate elements are nothing but the interstices between many bundles (Entw. d. Bindesubstanz, p. 28, 1858). Virchow has, however, replied to his arguments in vol. xvi. of his Archiv., p. 19.

Recent observations would tend to indicate that the question of the existence of an independent canal system is capable of a still further development. Several excellent microscopists have traced a connection between members of the group of

connective tissues and Virchow's first great class, the epithelial formations. Thus Gerlach has traced a continuity between the ciliated cells of the aqueduct of Sylvias, and the processes of the underlying connective tissue corpuscles (Mikrosk. Studien. 1858). Heidenhain has traced these processes to the cylinder epithelium of the bowel in the rabbit (Moleschott's Unter-suchungen, 1858). Luschka has followed the processes to the epithelium of the endocardium (Archiv. vol. ix. p. 569). Similar observations are due to Eckhart (Beiträge anat in Physiol, 1855,) and to Billroth (Müller's Archiv. 1858), and these are regarded as highly probable by Friedreich (Archiv. vol. xv. p. 538.)

Thus the connective tissues, their analogues, and their alliances, are made to acquire an immense anatomical value, and this Virchow further extends both to the physiological and pathological relations of the economy. They afford him foundations for his great hypothesis of the individuality of the members of a tissue as consistent with their mutual dependence. We will next examine the chief bearings of this important doctrine.

"We must recognise the life of the individual parts and refer the same to a power, a motor force, which must not be regarded as the resultant of the molecular forces of the part, but as something communicated, as excited by some antecedent, a force, which although acting mechanically, cannot be mechanically compounded. There is no life but that of succession, and there must consequently be a persistent force that can be transmitted from member to member, in addition to those forces that are constantly coupled to matter. We distinguish two varieties of force within the body, the molecular and the (excited and exciting) vital force, by the joint action of which we obtain the elementary or cell force of the organic elements, in a more extended sense the vital force . . . . . . But no part of the body, however autonomic its nature may be, is absolutely independent of the others. The inherited movement which has been originally excited in a given mass of material provided with molecular forces, exhausts itself against the increasing resistances, unless the motion be maintained and strengthened by the supply of new material with new affinities and antagonisms. The vital force is regenerated by the molecular forces through the method of nutrition . . . . . Thus life persists in the whole body, as in every invidual cell-territory ; its uniform course is due to the harmonious, mutually compensating motion of many elements that originally

sprang from a simple element* (Allg. Formen. d. Störung u. ihren Ausgleichung, pp. 3–4–5). The physiological idea of a tissue is thus, to a great degree, brought into conformity with that derived from anatomy. It is demanded that the irritability of each cell be admitted, *i. e.*, that it should be capable of being determined to certain evidences of activity. The inference from this is, that the irritating cause (irritans) constantly resides externally to the cell, as it is only by the action and reaction subsisting between this force and those already extant within the cell, that the latter can be evidenced to the observer. This irritating cause may either act through neighbouring cells, or be communicated from a distance, *e.g.*, through the vascular or nervous systems, or have an originally independent existence. That activity is as constant as the life of the part is evidenced by Dubois-Reymond's researches into the so-called quiescent state of nerve. A cell change is thus induced, and it may either assume the form of generation, of growth, or of function, much depending as well upon the nature as upon the intensity of the exciting cause. Under all circumstances, "the idea of irritation necessarily includes that of counteractivity, and we are only justified in speaking of a part as irritable or excitable, so long as performances† proceed from it, such as neither simply pertain to the passive disturbance which has been induced from without (p. 8), nor to the molecular force which is inherent to it, although this may have a determining action on the force through which the part assimilates communicated movements and transmits them to

* Beneke has recently declared himself rather for a nuclear than for a cellular pathology (Archiv. des vereins fur gemeinsch. Arbeiter v. iv). This would scarcely affect the value of the laws here enunciated. Virchow himself admits, that the ultimate idea of his pathology is not the cell, but the life of the individual parts. (Archiv., vol. xviii, p. 10.)

† The term "performance," is here made to include the three factors, function, growth, and multiplication. Already some years ago, Virchow insisted on the necessity for accurately defining these (Archiv., viii, p. 27, ix, p. 47), and in his work on irritation and irritability, he demonstrated how function might be directly antagonistic to the idea of nutrition, as in the red blood disc, the seminal and mammary secretions; how within certain limits functional restitution might be independent of nutritive repair, as in nerve or muscle separated from the body, and submitted at intervals to stimulation; lastly, that growth or multiplication might interfere with function. He also argues, that the tendency of function should be separated from that of the other factors. "Function is essentially directed to the exterior, its chief importance is not for the part in functional activity, but for its neighbours (Reizung u. Reizbarkeit, p. 17). But in nutrition, every part is vegetative, and assures its own interests." (Archiv., vol. vi, p. 384.) Nevertheless, function becomes the ordinary excitant to nutrition, although itself excited by causes entirely extraneous. This gives the pathological value to the functio lœsa. Similarly, functional formative and nutrive restitution must be separated.

neighbouring materials (p. 12)." The chief thing is, and remains, the irritation, *i. e.* the change of the tissue. It is the *primum movens* of the process, and determines the reception of more abundant contents into the tissue, even when there is no vessel in the neighbourhood, and when the only possibility that remains is that the irritated element should derive its contents from the adjoining elements" (Reizung u. Reizbarkeit Archiv. vol. xiv).

Thus we have to discriminate between the exciting causes (irritans), the local disturbance which they induce (irritamentum), and the further active disturbance of the continuous or contiguous parts which necessarily result (irritatio). Certain external influences induce disturbances of the vital elements, and certain tensions proceed from them. But the life of the parts and of the whole can only so long pursue a regular course, as it is possible to counterbalance or to remove these tensions. If this be not effected, the state of irritation (irritatio) is established, and so we are brought to the limit of healthy action. The physiological or pathological value of an irritating cause, will depend on the difficulty encountered in its neutralization, from the "character of danger" that results. As regards the tissue, "any process that materially alters its performing power, especially for any length of time, and opposes the early restitution of a regular state, must be considered as morbid." The effect will vary mainly in proportion to the nature and intensity of the irritant. The cells of the tissue may simply give evidences of functional reaction, or they may increase in size, "hypertrophy," in number, "hyperplasia," or cell derivatives may be produced at variance with the parent stock, degeneration, pathological substitution, or lastly, the death of the part may be induced, either immediately, or by a descending process of metamorphosis. That functional activity is a property of the tissue and not of the excitant, needs at the present day no circumstantial proof, still Virchow quotes Dubois-Reymond, Ludwig, Bernard, &c., on this head.

That series of processes by which nutrient irritability is evidenced is, however, far less generally admitted, that faculty of the individual parts to absorb and deal with more or less material in answer to determined stimuli. They are, moreover, made to play so large a part in the most diverse pathological phenomena, that it will not be uninteresting to note how our author handles them, and first as regards inflammation.

" A series of inflammatory processes presents in its earliest evidences, nothing beyond an increased reception of material within the cells, just as has been remarked of simple hyper-

trophy.   If the history of the usual course of Bright's disease
be considered, it will constantly be found that the earliest
phenomenon which is to be detected, is that the epithelial cells
within the still intact urinary canals, although known to be
of large size, still further enlarge.   The renal tubes thus get
filled with epithelial cells, which are not only very large, but
very hazy, inasmuch as the interior of these cells has taken up
a more abundant supply of material.   The entire renal tube
widens, and appears to the naked eye as a tortuous, white,
opaque body.   If a solitary cell be isolated, a difficult task, as
the cohesion of the individual cells is already apt to suffer, a
granular mass will be found within it, which apparently only
consists of those granules which are otherwise present in the
interior of gland cells, the accumulation of which, however,
becomes denser the more energetically the process advances,
so that ultimately even the nucleus becomes indistinct.   This is
the condition of *cloudy swelling* as it is found in many irritated
parts, as an expression of irritation, and as a concomitant of
many forms of the so-called Inflammation.   Tracing this
process backwards, we find no cognizable limit between it and
simple hypertrophy . . . . . . In these processes it is scarcely
possible to wrest from the individual element the faculty of
spontaneously inducing an increased reception of material in
answer to a stimulus acting directly upon them ; at least, it is
opposed to all empiric experience to assume, that such a recep-
tion must of necessity result from special innervation.   If we
select a part which all observation indicates as destitute of
nerves, say the surface of an articular cartilage, we shall be
able, as the beautiful experiments of Redfern long ago proved,
to produce identical effects upon it by direct irritation . . . . .
It would be contrary to all experience to imagine that a nerve
in the medulla of the bone could exercise a special action upon
those superficial cells which were the site of the irritation,
without the cells which are situated between the nerve and the
irritated spot being simultaneously involved.   If a thread be so
drawn through a cartilage, as only to cause traumatic irrita-
tion, all the cells that border the thread will increase in size by
the reception of more material. The irritation which the thread
occasions only extends to a certain distance into the cartilage,
whilst the outlying cells are totally unaffected . . . . .   There
are truly few tissues in the body so destitute of nerves as
cartilage; but even if the most nervous parts be traced, the
extent of the irritation, or more properly the extent of the
hearth of the irritation, will in no wise be found to correspond
with the dimensions of any given nervous territory, but, in

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an otherwise normal tissue, the size of the hearth will essentially answer to the extent of the local irritation. If this experiment be transferred to the skin, a large series of nervous territories will be cut. But the entire territories of the nerves which lie along the thread, are in no wise placed in the same pathological condition; the nutritive irritation is confined to the course of the thread and its immediate neighbourhood . . . . . In a tissue in which this relation can be very distinctly followed, in the cornea, we find nerves in a position where no more vessels reach. These nerves have a reticular arrangement, and leave smaller or larger territories between them that are entirely devoid of nerves. If any irritant be applied directly to the cornea, such as a red-hot needle, or nitrate of silver, the circuit which is thereby thrown into morbid activity, in no way corresponds to a nerve circuit. It once happened to us to pass the cautery so as exactly to touch such a nerve filament in the rabbit, but the disease only manifested itself in the neighbourhood of this spot, and certainly not in the whole province of the nerve . . . . . In the first humble attempts that I made to modify the old views, I still retained the expression " parenchymatous exudation." I had convinced myself that in many places where tumefaction ensued, absolutely nothing but tissue was to be seen. In a tissue composed of cells, even after the swelling (exudation), I saw nothing but cells, in tissues with cells and intercellular substance, only cells and intercellular substance; the individual elements certainly larger, fuller, replete with a quantity of material that they should not have contained; but I saw no exudation as it is ordinarily considered, either free or in the interstices of the tissues. All the mass was contained within the elements themselves." (Cell. pathol., pp. 270–274). A great deal is not so much exudation, as if I may so express myself, *educt from the vessels in consequence of the activity of the tissue elements themselves* (Cell. Pathol. p. 350). " An irritation of the nerves may naturally co-exist, but putting function apart, this has no connection of cause and effect with the processes in the tissue proper, but is nothing more than a collateral effect of the original disturbance" (Cell. Pathol. p. 287).

I therefore hold that in the sense in which it is usually accepted, *there is no such thing as inflammatory exudation* (Cell. Pathol. p. 356), but that the exudation that we meet with, is essentially composed of that material which is generated by the altered condition of the inflamed part, and of the *transuded* fluid which escapes from the vessels."

This last expression frees our author from a reproach that

has been levelled at him, that his devotion to the cellular theory leads him to consider the vascular relations of the part as of no account.

If then, a part possess a large number of especially superficial vessels, it will give an exudation, since the fluid which has been transuded from the blood transports the special products of the tissue to the surface. If this be not the case, there will be no exudation, but the entire process will be confined to the occurrence of those changes in the tissue that the inflammatory irritation has induced. In this manner, two forms of inflammation may be discriminated; the *purely parenchymatous*, where the process runs its course in the interior of the tissue independently of the outpouring of blood fluid, and the *secreting (exudative) inflammation*, which more properly belongs to the superficial organs, where an increased outpouring of blood fluid occurs, carrying the proper parenchymatous materials with it to the surface " (Pathologie u. Therapie).

In one of his previous works, Virchow develops the importance of the vascular system in inflammation more fully. He agrees with H. Weber in referring the local disturbances of the circulation to two sources; the pressure from the heart, which represents the ordinary cause of mobility, and the molecular attraction that is active in the capillary circulation. He considers the major part of them to be the results of the irritation, and that no part of the residue is an unfailing concomitant of inflammation. In this sense he reviews brittleness of the vascular coats (Küss), the narrowness of vessels (Williams, Brücke), and their dilatation (Jones, Paget, Brücke), whether this latter be due to temporary relaxation of the muscular structure, to permanent atony, to increased blood pressure, or to the formation of new vessels. He also corroborates Majendie and Poisseuille's observations on the importance of the composition of the blood itself, as a cause of impeded or accelerated circulation. The internal cohesion of the blood, he proposes to divide into several factors, the density of the serum, the mutual attraction of the red blood discs, their relation to the surrounding serum, and the adhesion of the whole to the wall of the vessel. Each of these is capable of modifying the circulatory pressure in the inflamed part, and may so far influence the ultimate result, but they do not constitute inflammation. The only ultimate tangible effect that they have, is to cause simple transudation. " Exudations are always phenomena of irritation, simple transudation is a result of pressure " (Reizung n. Reizbarkeit, p. 36).

Our readers will naturally inquire how all this leads to the formation of an abscess, or of pus on a free surface. Pus is

defined to be " a young tissue, gradually loosening all firm inter-
cullar substance, in combination with a rapid cell development."
There are two methods of pus formation according to the kind
of tissue examined, whether it pertain to the epithelial or
connective series.   Whether forms of suppuration exist, that
may strictly be referred to muscle and nerve, Virchow still
considers doubtful.

   " If the development of pus on the external skin, without
ulceration, be followed, the suppuration will regularly be found
to proceed from the rete malpighi.   As the elements grow, the
harder layers of epidermis become loosened, and are raised as
a bulla or pustule.   The chief site of the pus corresponds to the
superficial layers of the rete that are already passing into
epithelium . . . . . .   In the deeper layers, one can trace how
the cellular elements, which originally have simple nuclei,
subdivide, the nuclei multiply, many new cells occupy the
place of the old one, and these again are provided with dividing
nuclei . . . . .   It is just the same on mucous membranes.
There is no mucous membrane which may not, under circum-
stances, yield pus.   But here also certain differences are to be
noted.   A mucous membrane is the more in a condition to
produce pus without ulceration, the more perfectly it possesses
pavement epithelium.   The mucous membrane of the small
intestine scarcely ever yields pus without ulceration.   In the
urethra, on the contrary, massive discharges of pus may exist
without the slightest superficial sore, as in gonorrhœa " (Cell.
Pathol. p. 401–402).

   Virchow acknowledges a certain resemblance between pus,
mucus and epithelium, and he refers them all to the same
fundamental form ; but once advanced beyond the embryonic
stage, their indentity ceases.   Mucous corpuscles are not young
epithelium, nor pus young mucous corpuscles.   Proceeding to
the second method of suppuration, he argues—

   " First the cells of the connective tissue enlarge, their
nuclei divide, and for a while sprout enormously.   To this first
stage division of the elements themselves succeeds.   In the
neighbourhood of the irritated part, where formerly solitary
cells lay, double and multiple cells will be found from which
generally a kind of homologous new formation is derived.
(Bindegewebe.)   But towards the interior, where the elements
were already full of nuclei, heaps of small cells soon appear,
which at first lie in the direction of the corpuscles of the con-
nective tissue.   Somewhat later, round hearths or diffused
infiltrations are found.   Within these the interstitial tissue is
very scanty, and is consumed in proportion as the sprouting
cells advance.   The tissue thus becomes infiltrated with pus

cells (abscedirt). . . . . . These forms gradually yield the so-called granulations, which always consist of a tissue where more or less numerous round elements, at least in the growing stage of the granulation, are imbedded in a small quantity of soft inter-cellular substance. The more closely the surface is approached, the more do the cells, which are uni-nucleated deep down, evince division of the nuclei, so that, at the final limit, they cannot be distinguished from pus. A detachment of epithelium now occurs, the ground substance becomes more diffluent, and the individual elements may be liberated. If the vegetation be abundant, the mass is constantly breaking up, the elements are poured on the surface, and a destruction ensues which eats deeper and deeper into the tissue. Thus we have an ulcer." (Cell. Pathol. p. 405-6.)

These views have already for some time been promulgated in Germany, and were distinctly advocated by Virchow as early as 1854. (Handbuch d. speciellen Pathol. n. Therap. p. 337.) They have been the source of almost endless discussion, and are admitted with more or less reserve by Förster. (Handbuch, 1855, p. 307.) Billroth, "The source of all pathological processes leading to cell-formation, whether it conduct to the formation of solid or of fluid parts, is chiefly to be found in the connective tissue, and especially in its cells and nuclei; and the cells and nuclei of other tissues either have no share, or only participate in a very limited degree in their production." (Beiträge, Path. Histol. 1858.) His (Beiträge zur normalen u. Pathol. Histol. d. Cornea, 1856), Böttcher (Virchow's Archiv. vol. xiii. p. 227) on suppuration in muscle and tendons; C. O. Weber (Archiv. vol. xiii. p. 74, and Archiv. vol. xv) who, in an elaborate and carefully reasoned article, describes suppuration in muscle, bone, periosteum, etc. "Here first the nuclei of the corpuscles of the connective tissue increase by subdivision, synchronously with an augmentation of the original cell space. The cells sometimes assume a rounded form, sometimes retain the spindle shape; ultimately large spaces are formed which are quite filled with rounded nuclei, exhibiting $1-5$ nucleoli, and which are quite similar to pus corpuscles.* But often, also, division of the cells is witnessed. In the place of a spindle-shaped body a deeply indented corpuscle is seen, then two conical cells with their bases apposed, then three or more, and in them again often growing nuclei." But it will not do to forget that these views have been much questioned, and are, we believe, still opposed by Vogel, Schwann, and Reinhardt.

* Virchow questions this method of production, and adheres only to that by successive divisions of the cells. (Archiv. vol. xviii, p. 12, 1860.)

Another highly interesting aspect of this hypothesis is its relation to a fibrinous exudation. Here much depends on the value which is attached to the fibrin itself; and we must make a slight digression, in order to state our author's estimate of it. In a former work (Archiv. vol. i, p. 570), he maintains that the term Fibrin should only be applied to the coagulated product of certain fluids, as coagulation is the sole reaction that we possess of its existence, and that the condition in which this material pre-existed in the fluid should be called fibrinogen. Arguing from the length of time required for different fluids exposed to the air to coagulate, and from the fact that lymph and chyle never coagulate within the body, he establishes an ascending series of these fibrinogens, the most imperfect of which is found in the minutest ramifications of the lymphatics and lacteals. The cause of coagulation he finds mainly in the exposure of the fibrinogenic substance to the influence of oxygen, and he considers the coagulation of blood between ligatures to constitute no objection to this view. "The blood, which has been brought to a stand by ligature, always contains a certain amount of oxygen; and if this oxygen be for the most part present in the blood discs, we might certainly anticipate that they would gradually evolve the same. If arterial blood contain more oxygen, coagulation should be more complete, and this is actually the case." (Gesammelte Abhandlungen, p. 133.)

He sums up this part of the argument by saying, "that in none of the normal fluids perfect fibrin, as such, pre-exists: on the contrary, the blood only contains a substance more nearly, the lymph and the lymphatic fluids more remotely allied to it, and that these by contact with oxygen become, sooner or later, transformed into real fibrin and then coagulate." (Gesammelte Abhandlungen, p. 133.)

In the present volume he repeats many of the elaborate observations and experiments that have led him to these conclusions. Assuming, next, that in order to obtain a fibrinous exudation a preliminary irritation of the tissue must precede, he suggests three possible methods for its occurrence. "Either the vascular coats and the tissues are rendered permeable to fibrin, which they were not before; or the elements of the tissue, after the manner of secreting cells, attract the fibrin from the blood and then expel it; or the fibrin does not originate in the blood at all, but is generated by the parts." He supports the latter hypothesis, as then lymph and exudation would fully correspond. "If serous fluid transuded from the blood-vessels, the excess of this fluid would usually pass into the lymphatics, but under pathological conditions would remain piled up in the interior of the tissue, or transude to the surface."

(P. 136.) Should the lymphatics perform their office adequately, much fibrinogenic material would be conveyed to the blood, and a hyperinosis would result. This brings rheumatic fever quite within the scope of the present theory, as there exudation is slight, hyperinosis excessive. "Thus the ultimate source of the fibrin is not to be sought for in the blood itself, but at those points where the lymphatics collect the increased fibrinous mass."

These views Virchow still adheres to. In his Cellular Pathology he argues that "fibrin, wherever it be found in the body externally to the blood, is not to be considered as an excretion from the blood, but as a local production. I have endeavoured to introduce an essential change in the interpretation of the so-called phlogistic crasis, with reference to the localization of the same. Whilst one was formerly in the habit of regarding the changed composition of the blood in inflammation as existing from the first, and as particularly characterized by the primary increase of the fibrin, I have developed the crasis as the result of the local inflammation. Certain organs and tissues possess, in an eminent degree, the faculty of generating fibrin, and of favouring its abundant presence in the blood, to which other organs are infinitely less adapted. I have further pointed out that those organs, which most frequently present this peculiar connection of a phlogistic blood with a local inflammation, are generally abundantly supplied with lymphatics, and are connected with great masses of lymphatic glands; whilst the organs, that either contain few lymphatics, or in which lymphatics are scarcely known, exercise no appreciable influence on the fibrinous composition of the blood." (Cell. Pathol. p. 148.)

The exudation, in such cases, can be considered as the excess of the locally formed fibrin, which the lymphatic circulation was incapable of removing." (Cell. Pathol, p. 150.)

We have now sketched Virchow's method of dealing with one of the most complex series of phenomena that can result from nutritive irritation. We have incidentally found how these could be combined with formative changes in the production of pus. In simple nutritive irritation the condition of the germinating centre of the cell, the nucleus, is not affected; but a certain increment in the intensity of the exciting cause, whether it act slowly or rapidly, will also involve the formative portions of the cell; and, under all circumstances, multiplication of the nucleus would seem to initiate this new series of changes.

Virchow thus found division of the nuclei of the corpuscles of connective tissue in a melanotic tumor as early as 1851.

Kölliker described multinucleate cells as constituents of the marrow of foetal bone. (Mikrosk. Anat. vol. ii, p. 364–378.) Paget has described them as constituents of the myeloid tumor (Surg. Pathol. vii, 216–223); and great multiplication of the nuclei occurs in muscle near to the foci of irritation." (Cell. Pathol. p. 281.) Still, the pathological importance of all these does not equal that of the new formation of the cells themselves. This is the character which imparts to suppuration its prominence among the results of inflammation. Hence inflammation can never be considered as a simple process. Supposing even that the exciting cause affecting many tissues simultaneously be the same, the result will nevertheless vary with the histological value of each structure. Simple functional disturbance may result in the one, nutritive changes in a second, formative variations of different degrees of importance in a third or a fourth. The tissues that appear most susceptible of formative disturbance seem certainly to belong to the connective series. Virchow accepts this as so generally true, that he ventures to assert that, "with few reservations, the connective tissue and its equivalents may be considered as the common germ-stock of the body, from which the real development of new-formed parts is derived." (Cell. Pathol. p. 360.) This doctrine is presumed applicable to the formation of every variety of new growth; so that, with reference to this great histological law, pus and cancer may be classed side by side. The questions of rapidity of growth, persistence of vitality, etc., are, of course, not prejudged. The method of formation will take one of two directions. Either there will be simple division of the elements, as has already been described, or a series of endogenous changes may affect pre-existing cells. This latter may consist in the formation of large bladder-like spaces (Physaliden), or brood spaces filled with new elements may arise within the cells, as Virchow delineated in vol. iii. of his Archiv. He would combine the whole series of results dependent upon formative irritation under the one head of hyperplasia. When a cell mass begins to first evince formative reaction, it is impossible to determine the direction of the new growth;* but whether it be consistent with the pre-

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* Weber thus refers to this part of the subject: "We see, therefore, that in most new formations the connective tissue cells take the place of brood spaces. Why, in one case, the product should be a rapidly evanescent one, as pus corpuscles; in another, a spindle-formed cell or nucleus, as in fibroid and sarcoma; in the third, a round multinucleate cell, or large pale clear nuclei, as in scirrhus and encephaloid; or, lastly, a cell with epithelial characters, and proportionately thick firm wall; that is a question that we are at present quite incapable of determining." (Archiv. vol. xv, p. 526.)

existing structure of the part, or at variance with it, he urges that the product will still be analogous to some already formed portion of the body.

Thus even the physalides of cancer have their representatives in the thymus gland; and "wherever new formations are to arise in any quantity, an analogous substitution occurs according to the type of young medullary tissue (granulation). So that, however great the consistence of the old tissue, a kind of proliferation takes place, whereby the germs of the future products are deposited." (Cell. Pathol. p. 384.)

The use of the term heterologous, in its usual acceptation, is therefore combated; and it can only be employed to indicate that either in situation, in the time of its appearance or in extent, the new growth varies from its originating tissue. An analogy exists, however, among new formations, not solely at the time of their origin, but the ways in which they ultimately terminate their existence is very similar.

Hughes Bennett (Cancerous and Cancroid Growths) some years ago described the fatty degeneration of the older portions of cancerous nodules, and the same method of resorption has long been known to prevail with inflammatory infiltrations. " The form under which cancer finally ulcerates has so much resemblance to the ulceration of pus, that the two things have been long compared." (Cell. Pathol. p. 4.)

Is there, then, any broad characteristic by which new formations may have their relative value determined ? Virchow proposes the medium life of the individual elements as a criterion. " At a time when certain forms have already entered upon a retrogressive course, others first acquire their full development." Those with a fluid intercellular substance are the least adapted for persistence. But even in solid tumors it is requisite to discriminate between the entire growth and its constituent parts. We have mentioned how some of the latter may be in a state of retrogression ; and even those parts whose development is most parallel must be regarded as compounded of many minute foci. It is here that the anastomoses of the connective tissue acquire such importance. The very fact of extreme persistence—particularly if coupled with a great pro- clivity to produce new elements—would be some criterion of the intensity of the original irritation, and would lead us to anticipate an extended radiation of its effects. This really is the case. In malignant growths, " the zone of the last disease extends considerably beyond the zone of change which the naked eye can recognise...... This is the chief source of return after extirpation." Cancer, according to this, would

have a local origin and a contagious method of growth. The more extended the anastomoses of the connective tissue, the more rapid will be the progress of the disease. A difficulty meets us as to the development of remote secondary cancers. The origin of these Virchow is inclined to refer rather to the conduction of juices than to the transport of solid particles, although he is far from denying the occasional occurrence of the latter. Virchow would, then, altogether remove malignant growths from the dyscratic forms of disease in their humoral pathological acceptation. He even goes further, and rejects blood dyscrasias *in toto*. To every dyscrasia he would assign some local position from which the blood is constantly or from time to time contaminated. "Every dyscrasia is dependent upon a permanent supply of noxious ingredients from certain points." (Cell. Pathol. p. 120.) Be it observed, that he makes a dyscrasia to depend upon a permanent addition of hurtful materials to the circulating fluids. In our fevers with a typical course, the poison is only once brought into contact with them from a local source, and thus their duration is definite. We see, indeed, a permanent result in the ulterior protection that they afford; but this is less to be referred to a change in the blood than to a modification of that element. Bennett, in his work on Tuberculosis, has assigned to a variety of faulty assimilation the local source of disturbance which would act as the exciting cause in consumption. Thus two difficulties would be removed, to our adopting the law which Virchow has recently laid down, "that up to the present time no reason exists for the admission of primary permanent dyscrasias." (Archiv. v. xviii, 1860, p. 14.)

Having now given an outline of some of the most prominent members of the ascending series of nutritive and formative changes, it remains for us briefly to analyse their course in an opposite direction. The class of disturbances which here ensues is, both in its origin and in its effects, rather of a negative than an active character. Many of them may be induced in previously healthy parts by the simple absence of physiological irritation, as in a paralysed muscle. The whole of these passive processes Virchow would class under the head of degeneration, but "there is naturally a great difference whether the element, as such, persists at all, or is utterly deprived of vitality; whether at the end of the process it be still in existence, although in a much decreased capability for action, or whether it be altogether destroyed . . . . . Herein lies the great practical distinction; there is still a possibility of cell repair in the one series of processes, whilst in the other a direct repair is impossible, and

regeneration can only result by the substitution of new elements from the surrounding parts." (Cell. Pathol. p. 289.) The last of these categories he is inclined to class apart as "necrobioses." "These necrobiotic processes, which must be entirely separated from necrosis, lead generally to an ultimate softening. This starts with brittleness of the parts; these lose their cohesion, actually at last dissolve, and more or less mobile, pulpy or fluid products come to occupy their place." (Cell. Pathol. p. 290.) He distinguishes simple indurations, where the part retains some amount of its original activity from these necrobitic forms. The most important of these latter is unquestionably fatty degeneration, of which our author gives an excellent description, which, for the most part, so entirely coincides with those of many writers in this country that it need scarcely detain us. When attacking the coats of vessels without having been preceded by any other pathological process, Virchow describes it as affecting the inner layer of the intima, so that it cannot be confounded with true atheromatous states. "If such a spot be excised, it will be found that a fatty degeneration of the connective tissue corpuscles of the intima has occurred, and as these corpuscles are branched cells, we here acquire, not the ordinary form of round granular cells, but often very long, fine formations, becoming incidentally spindle or starshaped. (Cell. Path. p. 309.)

These changes he would sedulously separate from those dependent on the true atheromatous process. In a former work* he details a number of experiments and observations that he made to ascertain—first the possibility, next the situation of inflammation in the arteries. These investigations induced him to recognise the former, but to oppose those doctrines which would acknowledge the existence of an exudation from the inner coat into the interior of the artery, as contended by Rokitansky (Spec. Path. Anat., vol. i, p. 523). On the contrary, he would rather side with Gendrin and Andral in regarding the deeper layers of the inner coat as the site of the disturbance. In the volume before us he still maintains this view, and admits inflammation as the forerunner of the proper atheromatous changes. "This kind of inflammatory affection of the wall of the vessel is in point of fact identical with what would be designated an endocarditis in the parietis of the heart. No other difference exists between the two processes than that the one has more frequently an acute, the other a chronic course." (Cell. Pathol., p. 323.) Occasionally the antecedent

* Gessamelte Abhandluugen.

inflammatory process is so active as directly to induce softening
of the wall of the vessel, whilst fattily degenerated particles are
to be detected in the circumference of the inflammatory focus.
Usually, however, the strictly inflammatory signs are less
obvious, the connective tissue elements become enlarged, but
are earlier filled with fat. " On a section we observe the
scattered fatty elements to become thicker and lie closer
towards the centre, but generally still to retain the shape of
cells; towards the exterior they become smaller and more
scanty. All these cells are filled with strongly refracting fatty
corpuscles. Between these fatty bodies a reticulate ground
substance is interposed, the true fibrous basis of the intima,
which we distinctly see prolong itself externally into the normal
intima. . . . . . One could imagine the fat to be deposited in
interspaces betwixt the lamellæ, and there are still a few
histologists who do not acknowledge that the connective tissue
contains only cells and no cavities. If these parts be followed
to the surface the same arrangement which is present in the
fatty portions can be recognised in the simple, horny, semi-
cartilaginous layers. . . . . . The enlargement which the part
experiences through the process, and which we call sclerosis is
consequent upon an enlargement of the cellular elements of the
wall and a multiplication of the nuclei, so that spaces are often
found containing masses of nuclei. Thus the process starts.
In many instances partition of the cell ensues, and a great
number of young elements are found; these ultimately become
the seat of fatty degeneration and really perish." (Cell. Pathol.
pp. 328, 329.)

" The further the degeneration proceeds the more perfectly
is an inclosed hearth constituted by the destruction of the
deepest layers of the intima; ultimately it may fluctuate, and,
on a section, a pulpy mass may be evacuated, like pus from an
abscess. If this mass be examined, numerous plates of choles-
terine will sparkle before the eye." (Cell. Pathol., p. 325.)
Sometimes, however, the contents of these tumors is so
decidedly inflammatory that the finest young cell formation, free
smooth nuclei, and multinucleate cells with homogeneous cell
contents may alone be evacuated, as in a case described by our
author. (Gesamelte Abandlungen, p. 403.) It need scarcely be
added that a second series of changes ending in ossification
may terminate the inflammatory process. Virchow contends
that we then have to deal with true bone and not with simple
petrifaction. " This latter is usually found in the peripheral
arteries, so that the condition which is ordinarily held to be a
special criterion of the atheromatous process, inasmuch as the

radial artery is felt to be hard and chalky, and the popliteal and crural vessels have hard rigid walls, is no proof that we have to deal with an atheromatous state. This hardening is very frequently situated in the middle coat. The cretification actually attacks the middle coat, so that the fibrous cells of the circular layer are converted into chalky columns." (Cell. Pathol., p. 332.)

An inflammatory process in every respect similar to that which affects the arterial coats is also met with in veins. The doctrine of an inflammatory exudation into the interior of the vein is combated, and the deep layers of the inner coat are regarded as the true site of the process. This bears no necessary relation to any material subsequently found within the vein, as abscesses may form of such dimensions as to raise the inner coat up like a smallpox pustule, without the coagulation of the blood within the vein being the necessary consequence. Phlebitis may, however, become the condition for the formation of clot along the wall of the vein by causing irregularities or even ulcerations. Clot may also exist in a healthy vein without being either accompanied or followed by inflammatory signs. What then is the value of the "sequestrated pus" described by Cruveilhier in the interior of clots, and supposed to be drawn into that position from the wall of the vein by the capillary action of the coagulating fibrin? The material found is not purulent but puriform, it is due to the softening of the older layers of the clot, and is composed of finely granular detritus. This indeed occasionally encloses large cells, sometimes multinucleate, generally containing oil. These might be taken for pus cells, but the history of the clot indicates that they exist in it from its earliest formation, and consequently they are regarded as white corpuscles undergoing fatty degeneration. The red corpuscles break up much earlier, but are also found in rare instances. That an exudation should be formed on the inner surface of a vein and act as an immediately coagulating agent on the blood, according to the doctrines of Rokitansky, is considered as an entirely gratuitous hypothesis. (Spec. Anat. Path. vol. i, p. 525.) In some, "the process which is usually termed suppurative phlebitis, is neither suppurative nor phlebitis, but a process starting with coagulation and the formation of a blood thrombus, and afterwards issuing in the softening of the thrombi." (Cell. Pathol., p. 183.)

The etiology of the first formation of intravascular clot was many years ago elaborately investigated by our author, and the results were published in an elaborate series of papers,[*] since

* Froriep's Notizen, 1846. Traube's Beiträge, 1846. Archiv. vi, 1847.

collected in his Gesammelte Abhandlungen. It was then referred to two chief causes, slowness of the blood stream, and the presence of foreign bodies, the existence of the necessary fibrin being presupposed. "Let us then put inflammation aside, and let us adhere simply to the coagulation of the blood and to the formation of clot." (Cell. Path., p. 179.) When from any cause a portion of clot has once formed in a vessel, it acts as a nidus for the deposition of further portions of fibrin till the bore of the vessel is choked up. The older, softening layers of fibrin are thus precluded from entering the circulation; but no such protecting boundary exists laterally, and the process of softening extends till it reaches the wall of the vein; then this latter becomes affected, and pus may form within its walls. This bring us to the verge of the history of Pyämia, and Virchow admits a close but not absolutely necessary relation between the formation of thrombi and the development of this process. The next step, after the prelimary coagulation of the fibrin in any given vessel, would appear to be the detachment, not of the softened material, which is inclosed in a kind of capsule of young clot, but of fresh portions of fibrin recently deposited at the extremity of the thrombus. A small vein first gets choked with clot, then "the thrombus is continued beyond the ostium of the branch into the trunk, in the direction of the blood stream, grows in the form of a thick cylinder, and becomes greater and greater. This propagated (fortgeseter) thrombus grows out of all proportion to the orignal (autochthonic) thrombus whence it started. The propagated thrombus may acquire the size of a thumb, whilst the original one may be only of the diameter of a knitting needle. For instance, a mass as large as a thumb may be continued from the vena lumbalis into the vena cava. These propagated plugs are the real sources of danger; disintegration affecting them may lead to the closure of distant vessels. This is the site where the blood current breaks off greater or less particles. No blood at all flows through the originally secluded vessel, the circulation there is entirely interrupted; but in the great trunk through which the blood is still flowing, and into which the plugs of thrombus project from distance to distance, the blood stream may separate smaller particles, drag them with it, and wedge them fast in some arterial or capillary system. Thus, ordinarily, thrombi from the periphery of the body cause secondary plugging and metastases in the lungs. I was long doubtful how far I might refer all metastatic pneumonias to this source, as it is very difficult to examine the vessels of the smaller metastatic hearths, but I am becoming more and more per-

suaded that this method of origin is the rule." (Cell. Pathol., pp. 185, 186.)

Thus emboli are formed. Their subsequent situation will vary according to the nature of the vessel containing the primary thrombus, and according to the size of the emboli themselves. Their effects are often perfectly imitated by fragments detached from the endocardium, as has been admirably shown by Dr. Kirkes, and by Virchow's own observations. (Med. Chir. Trans., vol. xxxv.) The brittleness of the embolus would also appear to have some regulating effect on its ultimate position, as it renders it liable to be broken up and dispersed into a very large number of small vessels. "Thus capillary emboli are constituted, one of the most important forms of metastasis, and one that frequently leads to small hearths in the kidney, the spleen, and in the substance of the heart itself." (Cell. Pathol., p. 189.) Once wedged fast, the embolus in its turn becomes enclosed in a capsule of fresh fibrin, and then undergoes chemical changes. Upon these depend the secondary importance of the whole process. If they are of a putrefactive character they will induce the most disastrous results round about them. On the contrary, both the secondary and primary disturbances may run a favourable course through the retrogressive change of both embolus and thrombus. Virchow is far from regarding pyœmic processes as exclusively dependent on the history of thrombosis.

"It is still necessary to take another fact into consideration, which is neither accessible to rough nor to minute anatomical inquiry; this is constituted by certain fluids which in themselves have no immediate or necessary relation to pus, but have obviously different constitutions and origins." (Cell. Pathol., p. 191.)

This affords a link between pyœmia and the dyscratic processes, and Virchow is inclined to admit an "ichorous infection" as one form of dyscrasia.

We are still far from having passed in review all the subjects of which this highly interesting work undertakes to treat. The description which it affords of Leukœmia, Tubercles, Ossification, Rickets, Caries, Amyloid Degeneration, etc., all, without exception, are beautifully rendered, and almost entirely original. Most of these subjects have, indeed, been largely dealt with by our author in his former publications, but nowhere do we find such elegantly worded, clear, and succinct accounts of them as in the work before us. Ere we conclude, we would venture to suggest one question, which can scarcely be said to invalidate any part of Cellular Pathology, but which would slightly modify

one of its interpretations whilst obviating one of the main difficulties to its acceptance. Is it perfectly essential that the cell as it is usually considered, that is a compound of nucleus, contents, and membrane, should always be the *primum movens?* In many situations the cell-membrane is extremely difficult of demonstration, and nowhere more so than in the secreting portion of glandular organs.* Neither does it seem to us that the existence of a cell-membrane is absolutely essential. The nucleus may represent one aggregation of matter, the cell-contents another, differentiated from the first. The nucleus may provide for the growth and multiplication of the whole, and what are usually termed the residual cell contents, in other words, the extra-nuclear aggregation of matter may preside over function. Growth would still represent molecular, multiplication numerical increase, but all the faculties of increase would be referred to the same centre, the nucleus. Thus, in inflammation, the irritation by a mere increase in its intensity could change from one faculty to its analogue, without even the site of its action being in any way changed. The one degree would lead to the existence of the cloudy swelling around the active centre, the other to the multiplication of the centre itself, either simultaneously or independently. The enormous difficulty (as Dr. Beale and others have pointed out) that there must be in acknowledging the involution of a double fold of membrane and its union with a corresponding involution from the opposite side of the cell would thus fall away. If the nucleus be considered as multiplying rapidly, the complexity of such a series of involutions would become extreme. The difficulty vanishes the moment the necessity for a cell membrane is abandoned. Then the mere force of attraction which would emanate from the nucleus would suffice to maintain a certain amount of " cell " material around it, and, when the segments of a multiplied nucleus separated, to account for the processes of cell fissure that have been described. Just as we have " cell territories " partitioned out in the intercellular substance, the cell itself would be the expression of the nucleus territory. Neither would this interfere with the conclusions to be drawn from such tissues as present a demonstrable cell-wall. This acceptation would favour E. O. Weber's observations that the nuclei themselves may become the pus cells, whilst the cell membrane melts away with the interstitial tissue to constitute the liquid portion of the pus.

We cannot close this work without again recommending it

* On some points in the Anatomy of the Liver, by Lionel Beale, 1856, p. 48.

to the perusal of our readers. It is a well-composed and agreeably written digest of those numerous and extraordinary changes that its author proposes to introduce in the history of Pathology. An acquaintance with the great principles it enunciates is essential to any man who is really anxious to go along with his times. Whether its doctrines are destined to occupy a permanent place in the edifice of medical science must still be left an open question; but the startling propositions that it broaches, the careful and extended observation that it indicates, and the talent and depth of its reasonings, all put it forward as one of the most valuable additions which this age of scientific research has experienced.

JOURNALS WITH WHICH THE "ARCHIVES OF MEDICINE" IS EXCHANGED.

Glasgow Medical Journal.

Journal de la Physiologie de l'Homme et des Animaux, publié sous la direction du Docteur E. Brown-Sèquard.

American Medical Monthly.

North American Medico-Chirurgical Review.

Archiv. für die Holländischen Beiträge zur Natur und Heilkunde.

Guy's Hospital Reports.

American Medical Times. A new series of the New York Journal of Medicine.

Journal of Practical Medicine and Surgery. English Edition.

Quarterly Journal of Dental Science.

Ophthalmic Hospital Reports and Journal of the Royal London Ophthalmic Hospital.

Archiv. für Pathologische Anatomie und Physiologie, und für Klinische Medecin. R. Virchow.

*** The Editor will be happy to exchange with any other Journals.

ANALYTICAL NOTICES OF BOOKS RECEIVED.

Prof. Kölliker.   A Manual of Human Microscopic Anatomy.

This work contains 633 pages. It is a complete manual of human microscopic anatomy. The first part treats of general histology; the structure, formation, and function of cells: of the tissues, organs, and systems. *The second part* comprises special histology; of the external integument, the nails, hair, and glands of the skin: Muscular system: Osseous system: Nervous system: Digestive organs: Organs of deglutition: Stomach and intestines: Liver: Pancreas: Spleen: Organs of respiration: Urinary organs. Sexual organs: Vascular system: Of the higher organs of sense: Vision: Hearing and smell. The work is illustrated with 249 beautifully executed *wood-engravings*, and is provided with a very comprehensive and carefully arranged *index*.

Prof. Humphrey.   On the Coagulation of the Blood in the venous System during Life.

The author discusses the question as to whether the mingling of fibrinous and coloured masses in clots in the pulmonary artery can be taken as evidence that the clot was formed during life, and concludes that it ought not to be so considered; but that there ought to be some sign that the blood current has acted upon the clot, or there should be adhesion to the interior of the vessel, or other evidence that it was formed before death occurred, before the above conclusion can be arrived at. He does not say that such clots, which are usually considered to have been formed before death, are invariably post-mortem, but that they *may be so.* The memoir is illustrated by a coloured plate.

Mr. Charles Hawkins.   Sequel of a Case of Lithotrity.

The case was that of a man in whom a communication existed between the bladder and intestine. A calculus had formed in the bladder which had been removed by lithority. The patient recovered from the operation, but fæcal matter occasionally passed with the urine. His death seemed to be caused by general impairment of health rather than by the local disease. The opening in the bladder communicated with the sigmoid flexor of the colon, and was about the diameter of a goose-quill. The case is a good example of the value of lithotrity in complicated cases.

Mr. Henry Lee.   On the radical Cure of Varicocele by Subcutaneous Incision.

The author, before dividing the vein, places a needle under the vessel both above and below the part to be divided. Ligatures are then passed round the ends of the needles and over the vein. These are allowed to remain for a couple of days, when the blood in the vein will be coagulated. The vein is next divided by subcutaneous incision, and two days afterwards the needles are removed. Cases are subjoined illustrating the success of this plan of treatment.

Dr. Camps.   Case of Cerebral or Subjective Vision.

This was the case of a gentleman, aged 60, who was out of health, and was troubled both by day and by night with ocular spectres.   He was annoyed by the presence of a female figure in a grey dress which appeared in different places. The impression was so strong, that he believed he saw a real object.   He perfectly recovered under change of scene and attention to his general health.   The author remarks, that all such phenomena arise from perverted cerebral action, and are entirely subjective, and he suggests that, in some cases, they may indicate the commencement of disease of the brain.

George Murray Humphrey, M.D., F.R.S.   Observations on the Limbs of Vertebrate Animals: the Plan of their Construction; their Homology, and the Comparison of the Fore and Hind Limbs.

This work is illustrated with three plates, exhibiting outlines of the anterior and posterior extremities of various animals.   The author expresses doubt as to the existence of an *archetype*, and thinks it would be better to substitute, for this term, *simple primary form*.   Although there can be no doubt that nature works from a simple form, and builds upon a uniform plan, there is no reason to assume that she works up to an *ideal or archetypal pattern*.   In attempting to trace approximations to, and divergences from, this supposed archetype, the author thinks the student may perhaps be fettered, rather than assisted, in his endeavour to comprehend and investigate nature's works.

Dr. Waller.   Summary of his principal Physiological Researches.

It is only possible here to allude to one or two of Dr. Waller's conclusions. In 1849 the author discovered a new plan for investigating the distribution of nerve fibres, founded on the fact that the *distal* extremity of a nerve becomes disorganised when the trunk is divided.   Fatty degeneration results, and by the presence of the fat globules the course of the nerve can be easily traced, upon microscopical examination, by the presence of lines of oil globules amidst sound fibres.   When the sympathetic was divided in the neck, the upper segment degenerated, showing that the course of the nerve is upwards.   In reunion of a divided nerve, Dr. Waller states that the *distal extremity becomes completely disorganised before reunion takes place.*   Fresh nerve tubes are developed from the centre towards the periphery.   Section of the posterior root of a spinal nerve causes disorganisation of the spinal portion only.   Of the anterior root disorganisation of the distal portion only.

Dr. Harris.   On the Nature of the Substance found in the Amyloid Degeneration of various Organs of the Body.

After alluding to the general properties of starchy matters, the author adverts to the importance of the greatest caution in investigations of this class; for Rouget has shown that it is very difficult to exclude entirely starch grains.   They are found in great numbers in dust, and are often met with on the fingers.   It is probable that actual starch granules derived from without have been described as amyloid bodies developed in the animal tissue.   The author considers that starch has not been proved to exist in the tissues, although a substance of an amyloid nature is undoubtedly present.   Two cases, in which amyloid bodies were found in the liver, and two in which they were present in the kidney, are recorded.   The author concludes that these bodies are not identical with amylaceous substances, but are allied to them.   No one has yet succeeded in converting amyloid bodies into sugar.

Dr. Joseph Jones. Introductory Lecture to the Course of 1859–60, in the Medical College of Georgia.

The author alludes to the responsibility of teachers, and the importance of correct medical education. He discusses the physical constitution and physiological relations of man, considers the relations of the intellectual and moral faculties, the character, order, and relative value of the different departments of knowledge in the work of education, and concludes by directing attention to the fundamental branches of medical science, and urging the student not to be contented with a superficial knowledge of the practical departments of medicine.

Dr. Eckard. De Glandularum Lymphaticarum Structura.

The author briefly states the opinions held by different observers, and then proceeds to relate his own conclusions. He seems to regard the lymphatic gland as composed of a system of imperfect canals lying in the meshes of the capillary vessels. Injection easily passes from the blood-vessels into the lymphatic trunks, and he finds that the capillaries divide into very small branches which may be traced into the trabeculæ of the gland.

Dr. Marcet. An experimental Inquiry into the Action of Alcohol on the Nervous System.

The results at which the author has arrived from numerous experiments are as follows. That alcohol acts *principally*, but not *exclusively*, on the nervous centres by means of absorption. That it exerts a *slight* but *decided* action on the nervous centres through the nerves, independently of the circulation. The action transmitted through the nerves may give rise to a shock, or temporary complete suspension of sensibility and mobility, although respiration continues, or it may produce no other visible effect than hastening death.

Dr. Joseph Jones. Observations on some of the Physical, Chemical, Physiological, and Pathological Phenomena of Malarial Fever. From the Transactions of the American Medical Association.

This volume contains the first results of a series of observations which the author is conducting upon the fevers of the North American continent. The book contains 419 closely printed pages. Numerous cases are given which have been carefully investigated. Analyses and microscopic examinations of the urine, blood, and other fluids, have been instituted, and many of the latest and most valuable physiological researches are embodied in the author's remarks. The literature of the various subjects under discussion is fully given, and numerous explanatory notes with references are added. The author also enters fully into the pathology and treatment of different forms of malarial fever.

Professor J. A. C. Giraldés. Recherches sur les Kystes Muqueux du Sinus Maxillaire. Mémoire Couronné par l'Académie des Sciences, 1853.

After referring to the anatomy of the antrum, and alluding especially to its mode of communication with the nasal fossæ, with reference to catheterism and other surgical operations, the author proceeds to describe minutely the anatomy of the mucous membrane. The tubular glands in the mucous membrane are very numerous, and when the orifice is occluded dilatation of the gland takes place behind, and thus mucous cysts of the antrum are formed. There are two varieties of these cysts: 1. *Miliary cysts,* formed by the dilatation of the peripherial part of the excretory canal. 2. *Larger cysts,* formed by the dilatation of the entire follicle. The memoir is illustrated with three well-executed plates.

**Professor Bentley.   On the advantages of the study of botany
to the Student of Medicine.   An inaugural address delivered
in King's College, London, May 2nd, 1860.**

After alluding to the irreparable loss science had sustained in the death of
Edward Forbes, the author directs attention to the great importance of the study
of natural history to the student of medicine, and alludes especially to the direct
bearing of botany on practical medicine.   He advocates the establishment of
Wardian cases in the wards of hospitals generally for the pleasure which they
afford to the sick.   He then proceeds to show how the qualities of *correct observa-
tion* and *accurate discrimination*, so essential to the practitioner, are encouraged
by the study of botany, and speaks in warm terms of the advantages of his
favourite science as a recreation.   He concludes his lecture by drawing attention
to the evidences of *design* afforded by the study of botany, and encourages his
hearers to aim at being useful to their fellow creatures.

**Dr. Carter.   An Account of the Calculi contained in the Grant
Medical College Museum, with some general Remarks on
Calculi in India.**

In the college there are 119 urinary calculi from man, but very few biliary
calculi.   The *oxalate of time calculi* amount to 38·65 per cent., while in the
College of Surgeons these reach only to 14·75 per cent., in Guy's Hospital to
22·59 per cent., and in the Norwich Hospital to 13·27 per cent.   *Uric acid calculi*
are in smaller proportion than in England, and *phosphatic calculi* only reach
3·36 per cent.   These amount to 10 per cent. in England.   *Oxalate of lime forms
the nucleus* of calculi twice as frequently in India as in England; the author
discusses the causes which may contribute to produce this result.

**Samuel Cartwright, F.R.C.S.   Inaugural Address, delivered at
the opening of the London School of Dental Surgery.**

The author alludes to the great importance to the student of a regular scheme
of education, and offers some remarks upon the great advantages which will
accrue to the profession from the connection with the College of Surgeons.   He
shows that dental surgery has always been a department of surgery, and holds that
a knowledge of surgery and of the medical sciences generally is absolutely
necessary for every one who practises as a dentist.   The dental hospital will
afford opportunities for communicating knowledge not now possessed.   The
author concludes his address by advising his hearers to make themselves
acquainted with the collateral branches of science, and with general literature, to
gain an intimate acquaintance with anatomy and physiology, and a knowledge
of the principles of surgery; and he earnestly counsels them to look upon their
calling as a profession and to uphold it as such.

Dr. Bond.   On the Pathology of Chorea.

The author considers that the nervous system of choreic patients is constantly
generating an excess of nervous force, the tendency of which to escape by
emotional action is less under the control of the will than in healthy persons.
He shows that irritation of the peripheral extremeties of the nerves may excite
these and other nervous affections, and alludes to the importance of removing
these.   He advocates a nutritious diet, the cold douche, and draws attention to
the importance of the psychological treatment of the disease—to endeavour to
arouse the dormant power of the will, and to withdraw the attention from the
abnormal movements.   He strongly advocates the importance of gymnastic
exercises, and holds that a gymnasium ought to be an essential part of every
well-furnished hospital.

A. W. Page, M.D., Oxon. Oratio ex Harveii instituto in œdibus Collegii regalis Medicorum Londinensis habita, Junii xxviii, MDCCCLX.

The orator defends the use of the Latin language, and hopes that the custom of delivering the oration in Latin will be retained. He adverts to the Fellows of the College who have lately deceased—Chambers, Bright, Blackall, and Todd. With regard to the altered system of treating various cases of disease, the orator remarks that for some years past practitioners have found it necessary to lay aside more and more the use of the lancet, cupping glasses and leeches, and administer wine and support in cases in which it was the custom to deplete very largely.

Professor Bloxam. On the application of Electrolysis to the detection of the poisonous metals in mixtures containing Organic Matters.

By electrolysis the author was enabled to detect even the $\frac{1}{10000}$th grn. of arsenious acid, in an organic mixture, with the greatest certainty. The plan is more valuable for detecting antimony, and the latter substance is not so likely to be mistaken for arsenic as in the ordinary methods of testing.

Dr. John Struther's Anatomical and Physiological Observations (*continued*).

XVII. On Jugular Venesection in Asphyxia.

The author recommends that, in cases of asphyxia from drowning, the jugular vein should be opened about an inch above the clavicle as early as possible, and that as soon as the active flow of blood ceases, the wound should be closed and artificial respiration commenced. Blood regurgitates through the valves from the over-distended auricle. If the blood does not flow with moderate freedom, the author thinks it may be desirable to introduce a probe or blowpipe, or instrument like a female catheter, and pass it in gently for the distance of a couple of inches.

XVIII. Demonstration of the use of the round Ligament of the Hip Joint.

The mode of dissection required to expose the ligament and its uses are recorded. The paper is illustrated with views of the ligament in the different movements of the joint.

E. L. Hussey, F.R.C.S. On the Epidemic Small-pox in Oxford, in 1854–5.

The population of Oxford may be estimated at 27,000. More than 4,000 persons, or 1 in 6 were attacked with small-pox. The deaths exceeded 100. The author alludes to the habitual neglect of vaccination among the poor. Of 32 fatal cases, 24 had never been vaccinated, 4 probably not, and 4 only exhibited marks of vaccination.

CLINICAL OBSERVATIONS.

CASE OF MEDIASTINAL AND PULMONARY CANCER, ATTENDED BY GREAT LOCAL DROPSY AND HYDRO-THORAX, FOR WHICH PARACENTESIS THORACIS WAS PERFORMED ON TEN OCCASIONS.

By J. Warburton Begbie, M.D.,

Physician to the Royal Infirmary, and Lecturer on Clinical Medicine, Edinburgh.

Plate XI.

Case.—Archibald Hume, aet. 50, a quarryman and mason, presented himself at the Infirmary on Tuesday, July 10th, 1860, being desirous of obtaining my advice for what, in his own opinion, was a slight affection of the chest. The following facts in regard to his appearance and history were noted at the time, in the presence of several members of the clinical class. He is a powerfully made man, of sanguine temperament, five feet ten inches in height, and weighing fully twelve stone. There has been no loss of flesh or any remarkable failure of strength. Till within the last three weeks he has uniformly enjoyed good health, and has never suffered from any serious disease, neither has he ever met with any severe accident. His habits of late years have not been sober. A little more than a fortnight ago, without any exposure to cold, and while the weather was remarkably genial, he became affected by a short dry cough, and soon noticed, that while at work in the quarry, and particularly when leaving it on the conclusion of his day's labour, and ascending a pretty steep incline, his breathing became hurried and he was caused to pant. Within the last ten days he has ceased to work, on finding an increase of the cough and breathlessness: while, during the same period, he has consulted a medical man in the neighbourhood of his

residence (about four miles distant from Edinburgh), and by
his advice has been taking a cough mixture and applying
mustard over the chest.   There is something remarkable in the
appearance of the patient's countenance, it wears a decidedly
anxious expression, and, on careful observation, a slight
fulness of the right side of face is noticed.   He removes
his clothes, and as he does so, the right side of the neck is seen
to be decidedly fuller than the left; the jugular veins on the
former side are also somewhat distended.   Having further
remarked that his voice is a little suppressed in character, the
patient informs us, that a deviation from the natural condition
of his voice had been noticed within the last week or two, by
his wife particularly, but also by some friends.   He is directed
to cough, and on doing so we all observe that the cough is
peculiar, it is not a fully formed cough, not distinctly clanging
or ringing, but imperfect and barking in character.   A careful
examination of the chest was instituted, and with the following
results :—Chest well clothed; the fulness observable over the
right side of the neck extends below the clavicle and over upper
sternum.   Expansive movement of right side of chest somewhat
impaired ; left side moves freely.   Vocal thrill diminished over
upper right front.   On percussion, there is diminished resonance
under sternal half of right clavicle, and as low as nearly to
second rib ; over the upper sternum (specially its right half)
there is also decidedly impaired percussion sound.   [The situa-
tion of the dulness at this stage, as well as at a later period, is
represented in Plate XI, which, at the Editor's request and
through his kindness, accompanies the narrative.]   Neither
above the right clavicle nor over the sternum is any distinct
prominence detected, and in latter position there is no pulsa-
tion.   Very firm pressure on upper sternum causes pain, and
leaves a mark of pitting.   Percussion resonance over other
parts of the right front, in lateral region, and posteriorly is
normal ; over whole left side of chest it is likewise so.   Præcordial
dulness does not differ from that of health.   Heart's action is
somewhat feeble for so lusty a man ; its sounds are normal.
On auscultation under right clavicle and over dull region, there
is marked suppression of the vesicular murmur ; what sound is
audible has a bronchial character, is stridulous; and the same
remark applies to the breath sounds posteriorly, over the spine
of right scapula.   In other parts of chest on same side the
respiratory murmur is vesicular, though a little stridor inter-
mingles; but feebleness is its marked characteristic.   Over
the left side respiration is everywhere vesicular, much ex-
aggerated, puerile.   Radial pulses are noted to be rather feeble ;

there is difficulty in determining any difference in their force, therefore such cannot be remarkable, but perhaps the right is feebler than left (it ultimately became very decidedly so). The pupils present no deviation from their healthy state. The abdomen is now carefully examined; liver and spleen are found of normal dimensions; the urine is healthy (and it continued so); appetite is indifferent, it has been failing for some days; tongue is not clean, bowels are regular. Headache and a feeling of swimming in the head are complained of; sight is good. The carotid pulsation in right side of neck is certainly feebler than in left; but the integumental swelling may explain this. An unaccountable drowsiness has at different times over-come him during the past week. There is no swelling of feet or ankles. He lies on his back with an inclination to right side. There exist no other indications of disease.

Such were the particulars observed and noted on the occasion of our first examination of the patient. He returned the same afternoon to his own home, but owing to a very decided aggravation of his sufferings, and specially the occurrence of paroxysmal dyspnœa, became in the course of the next eight days an in-patient of the Hospital. On the 24th of July, his case was made the subject of observation at clinical lecture, when beyond a certain increase in the œdema of right side of face and neck, and over the upper sternum, while the right arm had also become a little swollen, the physical signs were substantially as already noted. The diagnosis was, as formed on the 10th; cancer commencing in upper part of the anterior medi-astinum, involving the summit of right lung, narrowing the main bronchus, interfering with the due return of blood from the head and right upper extremity, by pressure on the innominate vein probably, and perhaps already on the vena cana superior, (in the course of a short time this point in the diagnosis seemed certain,) while the peculiarity in the voice and cough, with the occasional attacks of spasmodic dyspnœa were accounted for by the probable implication of the right vagus and its recurrent branch. In the course of my observations on the occasion in question, the possibility of the symptoms and physical signs being determined by a tumour other than one of a cancerous nature, was not lost sight of, but the absence of the most characteristic signs of aneurism—of pulsation either visible or felt—and there being no marked implication of the circulatory system save what was evidently secondary in its nature, determined the diagnosis by exclusion. I considered mediastinal and pulmonary cancer to be the morbid condition with which the whole phenomena best corresponded.

The rest and comfort of hospital residence (it is truly surprising what this can accomplish even in desperate cases of all kinds) together with a properly regulated diet, and attention to the state of the bowels, the use also of diuretics which speedily increased the flow of urine tending to become scanty and seemed to prevent for a time any decided increase of the local dropsy—these were followed by an apparent improvement in the symptoms of our patient; and, grateful for the measure of relief thus afforded, he again bethought himself of home. His earnest request was acceded to; and, from the commencement of August to the 22nd day of September, he resided in his own cottage. There, I frequently visited him, accompanied by different members of the Hospital Staff, or by clinical students, enjoying also the counsel of my friends Dr. W. Sieveking, of Hamburgh, and Mr. Abbey.

For a few weeks no very decided change occurred, but early in September his case progressed with much greater rapidity—the dyspnœa in particular became more urgent, forcing him to maintain the sitting posture both by day and by night. The local dropsy moreover became greatly increased, the right arm, fore-arm and hand intensely œdematous; and the physical signs of hydro-thorax on the right side clearly established. On the 21st September, he yielded to my urgent desire to return to the Infirmary, and on the following day I had him conveyed there. On the 24th September, his state was as follows : Sitting in bed; respirations, thirty-six per minute; countenance somewhat livid; whole face much swollen, but right side considerably more so than left; lids of right eye so œdematous as completely to close it. Œdema of right side of neck and chest considerable; the swelling is no longer limited to the right, but has involved, though to a more limited extent, the left side. Nor is the chest alone affected; the abdominal parieties specially on right side are implicated, there is some œdema likewise of both feet and legs. Urine is scanty, under twenty ounces (not coagulable, sp. gr. 1·030, depositing urates; with normal amount of chlorides). The whole right side of chest yields a dull percussion; respiratory murmur everywhere nearly suppressed; at base of left lung over the other parts of which the breathing continues to be remarkably puerile, there is abundant sub-crepitant râle, and deficiency of resonance on percussion. Heart's action is feeble; pulse in right wrist very small, in left more distinct, ; frequency of pulsations nearly 100 per minute. Temperature of surface of body well maintained, skin dry. The following measurements were noted on this occasion.

Circumference of chest at level of nipples . 39 inches.
Measurement of right side . . . . 21 ,,
    ,,   left side . . . . 18 ,,
Circumference of abdomen at level of ambilicus 39 ,,
Measurement of right side . . . . 22 ,,
    ,,   left side . . . . 17 ,,
Circumference of right arm . . . . $14\frac{1}{2}$,,
    ,,   left arm . . . . 10 ,,
    ,,   right fore-arm . . . $15\frac{1}{2}$,,
    ,,   left fore-arm . . . 11 ,,

The patient has been taking diuretics freely since leaving the hospital; it is only recently that their effect seems to have been lost. For four weeks he has been unable to assume the recumbent posture for more than a few seconds together. There being very evidently a large accumulation of fluid in the right pleura, and distinct evidence of œdema at the base of left lung, which the hydro-thorax on right side was calculated to increase, I resolved to perform paracentesis. Holding in remembrance the frequency of pleuritic attacks in the course of cases of pulmonary cancer I was fearful lest the existence of pleural adhesions might stand in the way of the ready performance of the operation, and perhaps also prevent the temporary good result which otherwise I believed we might anticipate. The patient now was much reduced in flesh and strength. I deemed it, therefore, prudent to use the exploring trochar and cannula, and fearful, of inducing syncope, further determined to remove only a small quantity of fluid—should fluid come.

I entered the trochar in the lateral region between the fifth and sixth ribs, at the spot indicated in the plate. Serous fluid escaped through the cannula at temperature of 98° Fahr. Twelve ounces were removed; and then owing to the patient becoming very pale and expressing himself as feeling faint I desisted.

The fluid when examined had a pale straw colour; was perfectly clear, sp. gr. 1·017; indorous; coagulated on the application of heat, and addition of nitric acid. Microscopic examination revealed nothing.

On the following day, 25th September, paracentesis was repeated, when fully *thirty-five* ounces of a similar fluid escaped. The patient now felt some measure of relief, and after twelve hours the local dropsy seemed to have subsided considerably. That night he lay, for the first time for several weeks, on his right side. So satisfied was the patient of the greater freedom in breathing, and of the increased comfort in all respects produced by the operation, that he became solicitous for its frequent

repetition. It was had recourse to as follows, for the third time, on

September 28th,   25 ounces removed.
October   1st,   110   ,,   ,,
   ,,   5th,   40   ,,   ,,
   ,,   8th,   35   ,,   ,,
   ,,   10th,   120   ,,   ,,
   ,,   13th,   70   ,,   ,,
   ,,   15th,   55   ,,   ,,
   ,,   16th,   50   ,,   ,,

Thus, on the ten occasions on which paracentesis was performed the total amount of fluid removed exceeded 550 ounces. The characters of the fluid remained unaltered. During the opera- tion the entrance of air was effectually guarded against. The amount of fluid withdrawn varied considerably at the different operations; this was in great measure determined by the patient's condition. Such an amount was allowed to flow, as rendered his breathing easier; but particularly caused his com- fort generally to be increased. If he was pale and felt pain, which on the 3rd, 5th, and 6th tappings, he did more than on the other occasions, the cannula was at once removed, and a pledget of lint applied over the wound. On each of the succeeding operations the trochar of medium size, was introduced in the immediate vicinity of the first entrance. A clear percussion over a considerable part of the right sub-clavicular and mammary regions, and in scalpular region posteriorly was noted when a considerable amount of fluid was removed, as after the 4th and 7th operations particularly; then also a very feeble and distant respiratory murmur in the same situations met the attentive ear. Before each performance of the operation, either a full glass of port wine, or a little brandy was administered to the patient.

Respiration never again became so embarrassed as it was antecedent to the first operation, and after the second he could always maintain at will the recumbent posture on right side. Symptoms of disordered cerebral circulation now however arose to complicate the case, at times during the last fourteen days of life the mind wandered; at times, too, he saw only imperfectly. Sometimes he was afflicted by double vision. Occasionally he awoke from sleep quite bewildered, in a great fright, or even with a loud and very appalling scream. During the week which preceded the close of life, he had many attacks of momentary unconsciousness, and distinct convulsive tremors were seen during several of these seizures, by my able and zealous resident physician in the hospital, Dr. William Anderson. With the

levelopment of these symptoms there was the advance of a gradual asthenia, the countenance became very pale, though to the last there was no trace whatever of the malignant cachexia discernible in its lineaments. On the 16th October, he was very drowsy and very feeble; at visit of that day (12 noon), I concluded that I should not see him again; he died that afternoon without any struggle.

POST-MORTEM.—The body was examined the following day, by Dr. Haldane. There existed considerable œdema in the situations already indicated. On removing the sternum a large mass of encephaloid cancer was disclosed lying under the upper third of that bone, stretching into the right lung, nearly the entire upper lobe of which was involved, while the bronchus was greatly narrowed; the lower lobe of the right lung, was much compressed. Serous fluid to the extent of several ounces occupied the right pleural cavity, and at several places the costal and pulmonic surfaces were united by pretty firm adhesions. Some old tubercle was found in both lungs. The mediastinal cancer surrounded the vena cana, and large thoracic veins on the right side, it extended downwards to the immediate vicinity of the heart. The other organs of the body were healthy; microscopic examination revealed distinct cancer cells, particularly in the milky juice yielded on pressure from the mass in the lung.

As in many recorded instances the cancer in this case had its original seat in the mediastinum, and from thence passed to the right lung. It is unnecessary to dwell at greater length on the high value of the physical signs in establishing an accurate diagnosis even at the very earliest period, the facts have been but unsatisfactorily stated if their importance be not at once recognized. I am disposed to point with some confidence to the benefit resulting from paracentesis; great relief was undoubtedly secured, but life was I further believe prolonged for some weeks, weeks most valuable to the poor sufferer in a way I need not remark upon here.

SOFTENING OF PATCHES IN LEFT HEMISPHERE OF THE BRAIN, WITH HARD CRETACEOUS MASSES.

By W. E. IMAGE, F.R.C.S.,

Senior Surgeon to the Suffolk General Hospital, &c.

I WAS first consulted by the Rev, J. B. P. D——, Bury St. Edmunds, December 27th, 1859. Dark hair, dark eyes, sallow complexion, rather thick lips. He was a strong and well-made man, but he had been for many years subject to occasional attacks of low spirits. He was a man of considerable mental power, and had during the last few years, devoted much time in studying, by the aid of the microscope, the minute structure of fossil bones. When I first saw him, he was sick, had pain in the head, which he referred to the left temple and frontal bone; his pulse was very peculiar, varying from 28—65 in the minute, with intermissions, and during the illness it never increased beyond 65. His tongue was slightly coated, bowels regular, urine normal. He had been sleepless for several nights before I saw him; he was quite sensible, but very soon became bewildered by conversation; he looked worn and anxious; he occasionally wandered and was incoherent, but was always able to recover his mental balance if spoken to; his head was not hot, nor had he any other symptoms. Rest and support constituted the principle of treatment. After twelve days he became much improved, but he had not yet left his bed. One morning, however, after a rather restless night, he resolutely determined to get up and dress; his wife attempted to prevent him, but he was fixed in his purpose, and with the assistance of the nurse he accomplished his undertaking, and actually went down stairs, and drove himself five miles into the country, to the house of a friend, where he prepared himself for a day's rabbit shooting; on the discharge of his gun, the vibration caused him to fall to the ground, and he was brought home to Bury, greatly exhausted, sick, pain in head, and with great confusion of mind; his pulse was 40, very feeble. Without much change he continued in this state until Dr. Todd's visit, January 21, 1860. After great con-, sideration, Dr. Todd was inclined to the view of "red softening," and continued the former treatment of support, with iodide of potassium. After about six weeks he was apparently quite recovered, and began to resume his clerical duties, and was considered by all his friends to be restored to health

He continued apparently quite well up to December 31, 1860. A week before this last attack, his mind had been disturbed by trifling circumstances, and his temper had been irritable.

On Monday morning, December 31, at three o'clock, he had a very severe and prolonged convulsive fit, which almost twisted him out of bed. In about twenty minutes this was repeated, and these fits continued to be repeated at short intervals for two days, and then entirely ceased for four days and a half. In the intervals he was perfectly conscious, and described the fit by remarking that he had seen the same kind of fit produced in rabbits in which a pin had been passed into the brain. During this attack he was very little sick, and did not complain of so much pain as he had done in his former attack. After the expiration of four days and a half, the fits returned, and continued every twenty or twenty-five minutes up to within a few hours of his death, when he became very greatly exhausted, and gradually expired on the 13th January, 1861.

I omitted to remark that the right side of his body was partially paralyzed after the *first fit* on 31st of December, but sensation and motion returned almost perfectly after three days. Soon after the recurrence of the fits the right side was again paralyzed, and continued so until his death. He was sensible up to within a short time of his death, although it was impossible to understand him, as the muscles of the tongue were paralyzed. I particularly remarked that every time he was convulsed, the body was twisted quite round to the *right or paralyzed side*.

Post-Mortem.—January 17, 1861. On removing the calvarium, the dura mater was observed to have formed strong adhesions to the bone. The veins were much congested in the membranes; the right hemisphere was first examined, and it was a remarkably good specimen of healthy brain; the grey matter was in large proportion. On slicing into the *left* hemisphere, we soon came down to a patch of softening in the front of the anterior lobe, and on cutting into this chamber of softening, the knife was soon arrested by something hard; we then discovered three apparently cretaceous masses, the largest the size of a pea, the smallest about the size of a large pin's head, it looked to me like old tubercle; the softening had extended up to the membranes, and had just begun to involve them.

Every other part of the cerebrum, cerebellum, and medulla was perfectly free from disease.

ON SOME OF THE THERAPEUTICAL USES OF INDIAN HEMP.

By J. Russell Reynolds, M.D., Lond., F.R.C.P.

Assistant Physician to University College Hospital, &c.

ALTHOUGH Cannabis indica has been well known for many years as a " soporific," " anodyne," and " antispasmodic," it has been but rarely used; and the allusions made to it in therapeutic records have been generally to the effect that its action is uncertain, and sometimes injurious. These characters of its action must, of course, depend upon one, two, or all of three therapeutic stumbling-blocks: viz., the selection of a wrong case, the exhibition of an impure drug, or the administration of an improper dose. Exposure to the first and third of these Indian hemp shares with all other medicines; to the second it has been somewhat especially exposed. For a long time, I believe, none of the plant reached this country; but lately this difficulty has been overcome; and that which I have used in every case has been pure, and has been obtained from Mr. Squire, of Oxford-street.

Of the intimate action of Cannabis we know no more than we do of that of henbane, morphia, or hemlock; neither do we know less; whereas its evident effects are as conspicuous, and as definite as are the properties of any one of those medicines. Hemp is a soporific, anodyne, and antispasmodic; it relieves pain, and spasm, and it conduces to sleep; in doing either of these it usually promotes diaphoresis, and diuresis; whereas it does not leave behind it head-ache or vertigo; nor does it affect the appetite, nor confine the bowels.

I have never seen any ill effects from its exhibition when the dose has been duly regulated; varying from gr. $\frac{1}{6}$ to gr. $\frac{1}{2}$ for the child, and from gr. $\frac{1}{3}$ to gr. $1\frac{1}{2}$ for the adult. In two instances an overdose was taken by mistake. An elderly lady had the medicine prescribed for neuralgia of the fifth nerve, and taking more than the proper quantity, suffered for three hours from vertigo, and dimness of sight, with great difficulty in standing. A young lady, whose violent head-aches had been much relieved by doses of gr. $\frac{1}{3}$, repeated a dose too soon, felt almost immediate freedom from pain, and started with some friends to a white-bait dinner at Blackwall. Unaccustomed to the steam-boat, to whitebait, and to wine, she shortly began to be extremely lively in conversation, then to " clip her words," and suffer from confusion of vision; but whether in this case the result was due to previous head-ache, to the steam-boat, to

whitebait, hock, or Indian hemp, I could never satisfactorily determine.

I. In illustration of its beneficial effect in cases of mental or emotional disturbance, I will quote the following :—

Case 1.—A boy, æt. 8, whose brother died between eight and nine years of age, of what was called "cerebral congestion," has complained of frequent head-ache for five months. For the last fortnight he has had troublesome dreams; has waked up fancying he saw "giants running after his cousin and father ;" and "the roof of the room falling in." At another time he suddenly saw "things running about the room which seemed to talk to him in his mind ;" and when he fell asleep was very uneasy, with sighing respiration. He is a remarkably intelligent child, and beyond the symptoms mentioned appears in good health.

The sixth part of a grain of Indian hemp was ordered to be taken every evening, and after the first few doses perfect tranquillity was restored.

Case 2.—A merchant, who has travelled much, and of late years has not only had much "driving business" to attend to, but has suffered from yellow fever, has, during the last six months, become excessively depressed in spirits ; haunted with the gloomiest apprehensions ; and with suicidal thoughts. During the day he is often crying for hours together ; during the night he is restless ; lying awake until the morning, and then sleeping uneasily, and for a short time only.

Extr. Cannab. Ind. gr. ½ o.n. After the first dose he slept fairly ; he has since obtained good nights, and is much better in the day.

Case 3.—A gentleman, æt. 78, whose memory and mental powers generally have been failing for the last two years, and who has had several threatenings of paralysis, became, some months ago, extremely restless at nights. Usually he retired to rest about eleven o'clock, slept until one ; then awoke, and at once commenced incessant talking, getting in and out of bed, putting his clothes on and off, turning out drawers, &c. This, if not interfered with, he would continue doing for 2, 3, 4, or even 5 hours.

The effect of a dose of Indian hemp, from gr. ⅓ to gr. ⅔ was, within ten minutes, to induce calm and tranquil sleep, which usually lasted for 2½ or 3 hours. He would then wake again and begin the same manœuvres, when another pill was given. For many months this has been tried, and almost invariably with success. The dose has not been increased, no evil has followed, and the nights are now often so good that no pill is given.

II. For the relief of certain kinds of pain, I believe, there is no more useful medicine within our reach. The following may suffice as illustrations :—

Case 4.—A young gentleman, æt. 19, has for several years suffered from intense pain in the jaws, face, and head. In the cold weather he is pretty well ; hunts frequently, and gains flesh ; but as soon as the weather becomes warm he has epistaxis to a great degree, followed by violent pain in the face and head.

On July 7th he had suffered for three weeks ; had so lost rest at night that sometimes for a week together he had had no sleep at all. His appetite was bad ; he looked ill and careworn ; and had lost flesh rapidly. In the opinion of the dentist nothing more could be done to the teeth.

Ordered gr. ⅓ Cannab. Ind. formâ pilulæ o.n.

Tinct. Ferri. Sesquichlor. ʒss. t.d.

On July 14th had no pain since the first night of taking the pill. No epistaxis, no discomfort ; feels "quite a different person." Had not taken C. I. for 3 nights, and had been free from pain, sleeping between 7 and 8 hours.

Case 5.—A boy, æt. 7, in June, 1859, was noticed to keep the left hand clinched so that sometimes he could not release objects after having taken hold of

them. Soon after this he commenced suffering from headaches, which were very violent. They occurred once a week ; were so intense as to cause him to shriek with pain ; their locality was the forehead. He now drags the left leg in walking, is paralysed (partially) on the left side of the face ; is irritable and restless, but very intelligent. After obtaining negative results from a dose of male fern oil, I ordered Can. Ind. gr. ¼ bis. die ; with Potas. Iod. gr. iv. and Dec. Cinch. ℥j.

From the first occasion of my ordering this until I lost sight of the patient, *i. e.*, during a period of two months, there were no headaches but upon two occasions, the first within a few days after the commencement of the medicine, the second after the hemp had been discontinued.

Other symptoms remained, and many of the features in this case, inessential to my present purpose, were of great interest ; the child died during my absence from Town in the autumn.

Case 6.—A gentleman, æt. 59, has, for the last twenty years, suffered from pain in the right scapula, and corresponding portion of the spine. During the last three years there has been numbness and tingling down the right arm ; a feeling he describes similar to that produced by pressing on the nerve at the elbow. The painful spots are tender to the touch. Tongue clean. Appetite good. House dry. No gouty tendencies that he knows of. No vertigo ; nor headache.

February 21st.   Extr. Can. Ind. gr. ⅓. t. d. formâ pilulæ
                          Lin. Camph. c. Opio. pro usu.
                          Syr. Ferri. Iodidi m. xxx. t. d.

Within a fortnight the pain was completely removed ; the tingling sensation however, persisted. It should be mentioned that the iodide of iron had been taken before without effect.

Case 7.—A clergyman, æt. 70, in February, 1860, first complained of pain in the left side of neck and back. This was very intense ; extended to the head, and continued until May. He had then some difficulty in articulation. Tongue deviated notably to the left ; and its left half was coated with yellowish fur, the other half being clean. No paralysis of arms or legs. The head was held on one side and drawn towards the left shoulder. Arcus senilis marked. Spirits, depressed.

In this case the pain was quickly relieved by gr. ⅓ dose of Indian hemp, three times daily.

Case 8.—A complicated case of maladies arising, in a gentleman, æt. 28, from over-fatigue, accident, and injury to the back. Previously he had suffered severely from syphilis. Paraplegia, with anæsthesia of some intercostal spaces, and intense pain in the back, were followed by great exhaustion, anæmia, and epileptiform convulsions. The patient now began to suffer from paroxysms of intense agony in the occipital region, occurring two or three times daily. These resisted all ordinary attempts at relief, but yielded almost immediately to a few doses of Indian hemp. Occasionally there has been a threatening of their return, but for a period of 2 years there has been no serious attack ; and general health is now restored.

Case 9.—A young lady, æt. 19, of highly nervous temperament, but with no evidences of hysteria, has suffered from attacks of hemicrania, of great severity, for a period of 18 months. Change of air, various tonics, and alteratives have been tried without avail. The attacks are of almost daily frequency, the general health has become enfeebled, she dreads every kind of exertion and amusement for fear that it should induce the pain. Cannabis Indica was given in gr. ⅓ doses, thrice daily, and after the second day the attacks may be said to have completely ceased ; for there have not occurred more than two since that time, and these in each instance arose from the sudden discontinuance of the medicine. It is now more than 14 months, and no medicine has been taken for the last eight.

III. Notwithstanding the notable usefulness of Indian Hemp in the alleviation of pain, its value is, I think, still greater in the treatment of spasm of some kinds. It is of no use whatever in certain forms of convulsion, in other forms it appears almost marvellous in its action. I will illustrate this by three cases.

Case 10.—An officer in a cavalry regiment, æt. 28, is a remarkably fine man, of at least 6 ft. 2 in. in height, and with limbs of Herculean strength. For between three and four years he has suffered from attacks of an epileptical character, but merely "le petit mal." He suddenly loses his consciousness for a few seconds, and occasionally shows slight spasm about the mouth, with a little duskiness in the lower part of the face. He looks bewildered, forgets what he was saying, and after half a minute goes on again with what he was doing or saying. These attacks occur daily, sometimes 3 or 4 times in the day. He has never fallen down in one of them, although they have occurred when walking, and when on horseback, and, indeed, upon all sorts of occasions. His memory has gradually failed, he has become silly in manner, and somewhat childish in habits. For these symptoms he was treated by me from August to December, 1859, when a new train of phenomena occurred. He was in the country, hunting three or four days in the week; and on one of these days, towards the end of December, fell from his horse, but did not appear injured at the time. In two or three days, however, he became silent, moody, and extremely confused. He bought a number of articles that he did not want. On the morning of Jan. 1st, he was found on the floor of his room; having fallen probably in a slight attack while standing to make water, for the utensil was found on the floor, and broken. He talked incoherently, and complained of violent pain in the temples. The next day, on trying to get up, his head became much worse; he had no appetite. On the evening of the 2nd I saw him, he had then headache, photophobia, extremely contracted irides, deviation of the tongue to the right, considerable drowsiness at times, total anorexia, and a dirty tongue. On the morning of the 3rd he was excessively drowsy, and at about ten o'clock had a violent epileptiform convulsion. The attack returned within an hour, and during the whole of that day and night, and on through the 4th, 5th, and 6th, in spite of everything that is ordinarily employed in such cases, viz., leeches, blisters, ice to head, sinapisms, mercury, mercurial inunction, chloroform, ammoniacal inhalation, dry cupping, &c., &c., the fits did but increase in severity and frequency. Still between them he occasionally recovered consciousness, and in the intervals of attack the pupil was contracted, and there was no paralysis. On the nights of the 6th and 7th the fits were perfectly horrible, and tetaniform. There was complete opisthotonos, and this in a man of his bulk and strength was frightful. At this time I had not used Indian Hemp much, but the tetanic character of the spasms induced me to try it. A third of a grain was given, and repeated in 3 hours. After the second dose, the severity of the attacks diminished. After the third dose no fits occurred. He looked round about him with a silly, half-tipsy expression, fell asleep, and woke, after some hours, free from pain.

Since that time there has been no return of severe convulsion, but the slight attacks of "le petit mal" continue. Indian hemp appeared to exert no influence upon the latter. His general health is now good; but his mental faculties are most seriously impaired.

Case 11.—A gentleman, æt. 45, of robust appearance, and remarkably good general health, but whose life was of an exciting character, and whose mind and feelings were habitually strained to the utmost, had, on the night of December the 23rd, without warning of any kind, a violent convulsion. This was followed by sleep, heavy and stertorous; and after it, by maniacal excitement which lasted for fifteen minutes. This excitement passed into another fit, and in this state the patient continued, passing through a similar series of symptoms, about

once in the hour, for nearly 8 hours; the paroxysms continuing violent, and appearing to increase in violence. There was no return of consciousness between the attacks; neither was there paralysis, nor dilated pupil. These attacks continued in spite of bleeding, dry-cupping, cold to head, a blister (of hot water) to the nucha sinapisms to feet, enemata, &c. A grain dose of Indian hemp was given at 2 P.M.; it was rejected by the stomach, and another given as soon as possible, and retained. The patient soon fell asleep, slept for 3 or 4 hours, and had no return of convulsions from that time forward. His recovery was rapid and complete.

Case 12.—A young lady, of literary habits, and of 19 years of age, had when 5 years old frequent, almost constant vomiting, which lasted for a long time, and was supposed to depend on worms. Now, she is again suffering in a similar manner, and has been so for many months. She vomits after every meal, and this without nausea, pain, or vertigo. To a certain extent the vomiting is under control; i. e. for a time she can restrain it, as for example when in church, or in the drawing-room; but sometimes it is irresistible. The appetite is craving. Tongue broad, pale fur, papillæ large in front. Tonsils swollen. Bowels regular. Catamenia regular. She is slightly hysterical at times; tapping interscapular spinous processes gives an unpleasant sensation, and is followed by hysterical spasm of facial muscles. She has cold feet with chilblains. A large head, with prominent veins on the forehead and much pain at the vertex. She is cutting the lower "dentes sapientiæ." Her own idea is that the head is the cause of the vomiting.

After satisfying myself that there were no worms by giving fern oil, bismuth and lemon-juice were administered, but without the least effect upon the vomiting. She had previously taken many medicines without the slightest result.

On March 29, I ordered gr.⅓ of Indian hemp, three times daily, the dose to be gradually raised to gr.j. thrice in the day. When the latter dose was reached the sickness entirely ceased; it has never since returned, and her health is now perfect.

Case 13.—A youth, epileptic for three years, his fits recurring every two months, "to the day," and then rising to seventeen or eighteen in the twenty-four hours, was directed to begin taking Indian hemp three days before the fits were expected. This was done, and instead of seventeen severe attacks, he had but two or three, and these of "le petit mal."

In no one of these cases was the slightest discomfort of any kind occasioned by the medicine.

IV. The medicine has been, so far as I know, absolutely useless in some other cases to which I have administered it.

And first with regard to pain; 14. It utterly failed to afford relief in an obstinate case of sciatica, in which it was fairly and fully tried. Other measures were equally unsuccessful, until the subcutaneous injection of morphia was employed, and to this the pain immediately yielded. 15. In a case of so-called "hysterical hip-joint," it was useless, whereas the hypodermic method was perfectly successful. 16. In a case of distinctly hysterical head-ache it has proved utterly useless.

In several cases of epilepsy, I have given the drug a thorough trial, but it has produced no beneficial result in some; whilst in others it has exhibited the very doubtful virtue,—that possessed by almost every new remedy administered—of delaying, or for a time putting off the attacks. 17. One of these epileptic cases was of old standing, a single lady, aged 60, who

had had fits for 13 years. In this instance there was considerable, but only temporary diminution of the frequency.

18. Another was that of a young married lady, aged 21, whose attacks were rarer, and of less duration. No good resulted here.

19. A third case of failure, was in the son of a clergyman, a boy of 15 years of age, a mild and promising looking case. Indian hemp was well tried, but it did no good.

20. In a case of hypochondriacal self-torture, I have administered the hemp without relief. 21. In an instance of extreme loss of rest from an attack of temporary religious melancholia it proved useless; and 22, it did not procure sleep in the case of a highly nervous and diabetic individual, whose chief complaint was insomnia.

By placing these successful and unsuccessful cases in juxtaposition, we may, I think, gain some hints as to the class or type of malady upon which Indian hemp exerts its remedial action.

I.—*Mental and Emotional Disturbances.*

SUCCESSFUL.	UNSUCCESSFUL.
1. Deranged cerebral circulation, with pain, and delirium.	14. Hypochondriasis.
2. Incipient insanity after yellow fever.	15. Temporary, recurrent religious melancholy.
3. Senile ramollissement.	16. Insomnia with diabetes.

II.—*Painful Affections.*

4. Nervous irritation from carious teeth.	17. Sciatica.
5. Probable tumor of brain.	18. Hysterical hip.
6. Probable thickening of spinal meninges.	19. Hysterical head-ache.
7 Hæmorrhage at roots of 8th and 9th nerves.	
8 Syphilitic meningitis.	
9 Hemicrania.	

III.—*Affections of Motility.*

10. Meningitis.	20. Epilepsy.
11. Intense cerebral congestion.	21. Epilepsy.
12. Obstinate nervous vomiting.	22. Epilepsy.
13. Recurrent convulsions.	

Indian Hemp has been of no service in those affections of mind, sensation, or motility which are simply functional in their character; or which, at all events, have no established morbid anatomy. On the other hand, it has afforded notable relief, in cases where undoubted organic disease existed, viz., in examples of congestion, softening, tumor, meningitis, and hæmorrhage.

This medicine appears capable of reducing over-activity of the nervous centres without interfering with any one of the functions of organic, or vegetal life. The bane of many opiates and sedatives is this, that the relief of the moment, the hour, or the day, is purchased at the expense of to-morrow's misery. In no one case to which I have administered Indian hemp, have I witnessed any such results.

The value of the medicine appears to me enhanced, not because it fails to act in some groups of cases, but because this limitation of its action will, I trust, enable us hereafter, to apply it with scientific selection, and thus with that power which is the highest to be reached by art, viz., the prediction of results. Further, therapeutic agents have been the means by which questions have been so asked of Nature, that some of the most prized of her secret truths have been revealed in answer; and these have operated both directly, in regard of the art of healing, and indirectly also, by their contribution to that growing science of pathology, upon which, as its only sure foundation, all therapeutical success, beyond that which is merely accidental, or blindly empirical, must rest.

CASES OF PERFORATION OF THE PERITONEUM.

By A. B. DUFFIN, M.D.,

Assistant Physician to King's College Hospital.

THE following cases of perforation of the peritoneum which I have had the opportunity of examining during the last twelve months, are intended to illustrate some of the rarer pathological causes of this accident or to elucidate its diagnosis.

Case 1.—The first is that of a gentleman, aged 39 years. He had constantly resided in this country, and had enjoyed good health till a year ago, when he suffered from a very severe attack of obstruction of the bowels which was referred to the hepatic flexure of the colon. He had been similarly affected about a year before. From this he recovered in about five weeks and subsequently retained good health till about three weeks prior to his death. He was then suddenly seized with severe purging. The motions soon assumed a mucous character, and shreddy matters mixed with blood were evacuated. After five or six days, in spite of the use of opiates largely both by the mouth and rectum, the diarrhœa assumed a most alarming character. He passed as many as five or six motions in an hour, and the stools whilst becoming more copious were liquid

and highly offensive. Then, for the first time, he complained that the use of the enema syringe gave him pain, and his pulse rose above 80. Counter-irritation was applied to the abdominal surface, and the most varied astringent combinations were administered. These latter, however, the stomach refused to tolerate, although it never rejected the bland articles of nutriment and the wine administered. Even broths were well borne. After the disease had lasted about ten days, a new and curious phenomenon appeared. This was spontaneous diaphoresis. Consentaneously with its appearance the diarrhœa greatly diminished, but only to resume its sway on the cessation of the sweating. Following out this hint, Dover's powder, which had previously been administered to him was again largely given, and for about 48 hours with marked benefit. Then however it lost its efficacy. The motions assumed a red, brickdust appearance and the horrid fœtor returned. And now, about eight days before his death, two most ominous symptoms developed themselves. Tympanites along the track of the colon, and an irregular state of pulse, causing a variation of 20 beats per minute in the course of half an hour several times daily. Still the patient took his food readily and retained the opiates. Not only was the diarrhœa much subdued but the quality of the motions became more natural. It appears that on the 19th day of his illness at about 7 p. m. in the evening, he got out of bed to go to stool, and whilst there suddenly fainted in the arms of his attendant. About half an hour later his face was pinched and ghastly, and he had scarcely any pulse at the wrist. Still he complained of no special abdominal pain or distress, but of a general sense of uneasiness. He rallied slightly, and became delirious. He rallied further, the delirium ceased. He then talked with his family and composed himself to sleep. About half an hour later he started up furiously delirious, and died in a few minutes. Four hours and a half would fully cover the period that intervened between the moment of fainting and death.

Post-Mortem Examination.—The colon from the cœcum to the sigmoid flexure presented a series of ragged ulcers on its mucous surface. These chiefly occupied the ridges of the mucous membrane, but here and there ran into the hollows of the colon. These ulcers were especially distinct and numerous in the transverse arch of the colon, some being one and a half inches long by one inch wide. In places the membrane was greatly thickened so that the ulcers could eat deeply. In other situations, the muscular coat was also destroyed so that a layer of peritoneum the thickness of tissue paper alone maintained the continuity of the gut. The whole of this tract was greatly congested, the peritoneal coat sharing in this condition, and ecchymoses of various sizes were scattered through the substance of the gut. A greenish brown patch of mucous membrane existed at about two inches from the hepatic flexure, and about one inch from this was an actual perforation, quite circular, about one-sixth of an inch in diameter, lying on the posterior wall of the colon, and exposed when the great omentum was raised. No matters had been effused and no lymph existed in the peritoneal cavity. The other viscera could unfortunately not be examined.

Case 2 —Some months ago I was requested by Dr. Budd to perform a post-mortem examination on a gentleman who had died with the symptoms of sudden collapse and intense pain along the right side of the belly after an obscure illness, one of the most prominent symptoms of which had been a friction sound heard opposite the sixth rib on the right side a few days before death. Intense peritonitis existed over the right half of the belly and a superficial abscess, collapsed, but fully the size of an orange was found in the substance of the liver, opposite the point where the friction sound had been heard. Dense layers of lymph glued the liver to the diaphragm, and had probably been the cause of the friction sound heard during life. A smaller, immature abcess existed in the hepatic substance, but the whole of the rest of the organ was in a state of cirrhosis. There were no evidences of ulceration of the gut.

Case 3.—A lad, 12 years of age, was suddenly seized with severe griping pain in the stomach, so intense as to " bend him double." After 24 hours, vomiting became associated to this, and a dose of castor oil brought on watery purging.

On the fifth day of his illness he was admitted into King's College Hospital, under the care of Dr. Budd. His facies was then weary and anxious ; there was extreme tenderness of the whole belly, especially about the left iliac fossa. His breathing was thoracic. He was ordered opiates largely, demulcent enemata, and poultices to the surface of the belly. He survived his admission five days, gradually became more exhausted, and death was preceded by coffeeground vomiting.

POST-MORTEM EXAMINATION.—A quantity of pure pus was smeared over the intestines, filling the depending fossæ. Loose adhesions matted the bowels and the omentum. The vermiform appendix was black, ragged and sloughing, with a small perforation on one side. In it was impacted an oval concretion, three quarters of an inch long, having much the appearance of a date stone. Examined microscopically it proved to consist of an enormous mass of convoluted vibrissæ. The origin of these was elucidated by the acumen of the late House Physician, Dr. Sansom, who on cross-questioning the lad's mother as to his habits, found that he was much addicted to eat a variety of plumpudding, which is sold in pennyworths at cookshops. In this pudding, Dr. Sansom discovered hairs in every respect corresponding with those found in the concretion.

CASE OF ENCEPHALOCELE.

BY W. H. MICHAEL,

Surgeon, Cambrian Institution for Deaf and Dumb, Swansea.

MRS. P., aged 33 years, wife of captain of West India trader, pregnant with fifth child, expects her confinement at the end of December or beginning of January.

December 6th.—Complains of severe intermitting pain like labour (this continued for a fortnight, alleviated by opiates). December 21st, at noon.—*Os uteri* dilated to the size of a florin, pains had been severe for twelve hours. The membranes when ruptured released a large quantity of liq. amnii,. which continued to be discharged with every pain, nearly filling a large washhand-basin, placed at the side of the bed.

Presentation anomalous.—A soft body, divided into two parts by a construction about its centre, could be felt, filling up and gradually dilating the *os uteri.* During the pains, a smooth surface of bone beyond this, and continuous with it, could be distinguished; the impression given to the finger was that of very soft nates and the vulvæ of a female child; the proximity of the head made me conclude it to be a case of *spina bifida.* In half an hour from the rupture of the membrane, a female child was born, which lived 15 hours. It proved to be a case of encephalocele.

POST-MORTEM 60 hours after ; weather very cold. The brain closely adherent to the integument, was almost completely

out of the cranium, which latter was entirely deficient of the occipital bone. No deficiency of the ossific process, as such, for the bones were hard; the anterior portion of the head, although much flattened, quite consolidated, and the anterior fontanelle closed. The parietal bones terminated in a rounded and thickened ridge, as though they had been doubled inwards on themselves to make their margin. The surface of the brain was highly congested, and adhered very closely to the integuments, which, with the membranes proper, so far as they could be traced, were of a deep reddish chocolate colour; some blood had escaped from the lowermost portion of the bag in which the brain was contained, and here the integuments were curiously puckered or plaited. The brain substance, congested throughout, was reduced almost to a pulp, and the interior of the hemispheres filled with softly clotted dark blood; the optic thalamus and corpus striatum, larger than normal, were distinguishable in each. *No cerebellum.* The anterior portion of the hemispheres tapered almost to a point; the cavity proper of the cranium being reduced to very small proportions by the flattening of the parietal and frontal bones. The medulla oblongata flattened, appeared to be fused into the surrounding brain-matter from which it was hardly elevated. The spinal cord shrunken, and the size of a quill, about one-fourth filled the spinal canal, which contained a large quantity of sanious fluid. The cavity of the chest much constricted; heart normal; lungs thoroughly inflated, had apparently acted perfectly; weight 4 drams. The abdominal cavity was half filled by the liver, which weighed $2\frac{1}{2}$ ounces (avoirdupois). The large intestine was still filled with meconium, which had not been discharged, although the orifice of the anus was gaping. Total weight of child, 3lbs. $11\frac{1}{2}$oz.; length, 15 inches; circumference of head, taking in the most prominent part of the tumor, 14 inches; Antero-posterior measurement from root of the nose to spine, $7\frac{1}{2}$ inches. No food was taken by the child.

Mrs. P. has an idiot sister, 46 years of age, in appearance only 16. She was much alarmed by an accident to her sister-in-law on the 14th of May, 1860, who was thrown out of a phaeton, and died of tetanus on the 28th of the same month.

EXTENSIVE LESION OF POSTERIOR LOBE OF THE CEREBRUM ON
THE LEFT SIDE—SYMPTOMS SOMEWHAT RESEMBLING THOSE
OF DELIRIUM TREMENS.

By Gilbert W. Child, M.D., Oxon,

Physician to the Radcliffe Infirmary, Oxford.

Case.—J. I., aged 55, was admitted an out patient under my care at the
Radcliffe Infirmary.

August 7, 1860.—He had been a working gardener, and was somewhat
addicted to drinking until within the last few months. According to his wife's
account his head had always been a weak one, and easily affected by even a small
quantity of beer. During the last few months he had had a regular place, and
had not been known to be intoxicated. I had known something of him before.
He was a good workman, and his circumstances appeared to be comfortable.

On admission he complained of some heat and pain on the top of the head,
partial loss of memory and drowsiness. He exhibited also tremor of the limbs,
like that of a patient suffering under delirium tremens. His fidgetty manner
also suggested the idea of the same complaint. His pulse and tongue were
natural, his bowels regular, and his urine apparently normal. No further
symptoms presented themselves, and these appeared to have come on gradually.
I confined my treatment to moderate purgatives and tonics.

Aug. 14.—Symptoms remained unchanged.

Aug. 18.—I saw him at his own house, and found his confusion of thought
increasing, and becoming more and more like that which accompanies delirium
tremens; thus he could answer a question rationally, provided it required only a
word or two, but was unable to get through a moderately long sentence without
wandering from the point, and if left to himself he muttered and wandered.
His articulation, too, had become jerky and unequal. At this time he did not
appear to feel ill, but was dressed and walking about the room. A blister to the
back of the neck was now ordered, but it produced no amelioration of the head
symptoms, and he presently took to his bed.

Aug. 21.—The patient was become more drowsy, the bowels confined, and
the pulse slow, but of good strength. The bowels were opened with oleum tiglii,
but no effect produced on the other symptoms. He vomited once on this day,
bringing up his food and a quantity of bile. This symptom was repeated once
only during the course of his illness.

Aug. 23 *to Sept.* 3.—The state in which he now remained was as follows. He
lay in bed on his back, and was unable to turn himself. Paralysis of the right side
came on but very slowly and gradually, at first with some rigidity of the muscles
of the arm, followed by relaxation, and a return of rigidity was observable
towards the end. He was still able to answer reasonably when asked a simple
question, but soon wandered from the subject. When left alone, he would try to
get out of bed, and talk of going to his work. He was constantly fidgeting and
pulling about the bed-clothes with the non-paralyzed hand. During the whole
time there was no intolerance of light or sound, nor any difficulty in swallowing.
His pupils were perfectly sensible to the stimulus of light. He appeared to have
no appetite nor desire for anything; took no notice of any one who came into his
room unless they spoke to him; and passed his water and stools under him. The
bladder was not paralyzed. The skin was rather hot and dry. A remarkable
feature of the case was the extreme variability of the pulse, which changed
sometimes from 48 up to 120 in eight-and-forty hours.

The above symptoms were such that I was, of course, unable to come to any
satisfactory diagnosis, but I supposed the case to be one of either effusion into
the ventricle or central softening of the brain, and ordered him (Aug. 23) iodide
of potassium in 5 gr. doses every six hours, and a drachm of the strong mercurial

ointment to be rubbed into the arm twice a-day, and aperients when needed. He was also ordered port wine and water and beef tea, which was the more insisted upon, inasmuch as emaciation was progressing fast. The gums became sore in a few days, and were kept so, and a rash of a pustular character appeared on the face, especially on the forehead and the scalp, which was bald. No amendment took place.

Sept. 8.—The treatment was discontinued, and nitrate of potass only given.

After this the rash above mentioned gradually and completely disappeared. The patient had one more attack of vomiting, and the unconsciousness gradually deepened, and on Sept. 13 the breathing became stertorous.

The sensibility of the pupil remained unaffected. At 2 A.M., Sept. 14, he died.

POST-MORTEM.—The head was opened at 9 A.M., the next day, 31 hours after death, when the following appearances presented themselves.

The meninges showed considerable venous congestion, and some lymph appeared to be deposited in the course of the distended veins; the dura mater, corresponding to the posterior lobe of the left cerebral hemisphere, was discoloured. The convolutions of both hemispheres, especially in the parietal region, were somewhat flattened; on slicing the hemispheres of the brain they appeared to contain rather more blood than usual. The substance of the right hemisphere was of normal consistence; but the lateral ventricle was dilated to at least twice its natural size, and was about one-third full of fluid. The lateral ventricle of the left side was of the natural size; but the choroid plexus was found adherent to the external wall of the posterior cornu, and was in that part thickly coated with lymph. The whole of the brain substance of the posterior lobe was of a chestnut-brown or light mahogany colour and completely disintegrated, being excessively soft in consistence, and having what appeared to be little deposits of pus distributed throughout it. This disorganized portion of brain corresponded with the discoloured part of the dura mata above mentioned, and the disintegration appeared most complete in the neighbourhood of the posterior cornu of the lateral ventricle, where the choroid plexus was adherent, thus pointing to this as probably the first part affected. White softening extended from the above portion for some distance into the middle lobe of the brain.

The other cavities of the body were not examined.

Observations.—The following points in the above case appear to be worthy of notice.

(1.) The close resemblance of many of the symptoms during life to those exhibited in cases of delirium tremens.

(2.) The extreme variation in the rapidity of the pulse, unaccompanied, as it was, by any coincident changes in the other symptoms.

(3.) The fact that so extensive a lesion of the brain-substance could exist without giving rise to more violent symptoms, especially since an irritative or active state of the disease is indicated as having been present, according to Dr. Todd's law, by the rigid condition of the paralyzed muscles noted above.

(4.) The persistence of the reflex actions unimpaired almost to the last. This corresponds remarkably with the post mortem appearances which showed no lesion of any part of the encephalon concerned in their performance.

(5.) The pustular eruption which followed the use of the iodide of potassium. In the present case the eruption came out after the iodide had been employed for a few days, and began to disappear almost immediately on its discontinuance.

Similar effects have been noticed by Dr. Fischer, of Vienna, in the Med. Wochenschrift. See Lancet for April 28, 1860.

ORIGINAL RESEARCHES IN PHYSIOLOGY AND MORBID ANATOMY.

ON SACCHARINE FERMENTATION IN THE MILK WITHIN THE FEMALE BREAST.

By George D. Gibb, M.D., M.A., M.R.C.P.

THE substance of the present communication I brought before the Physiological section of the British Association for the Advancement of Science, at Oxford, on the 30th June, 1860. It is now given somewhat more in detail, and such omissions supplied as were then necessary from the nature of the audience.

The discovery of vibriones in human milk, by Vogel, was announced in a paper published in *Schmidt's Jahrbucher*, in 1853. He clearly proved that these animalcules were developed within the mammary gland, from the fact of their being seen in the milk on the instant of withdrawal. He believed them to be the result of fermentation in the milk itself, the result of congestion and increased heat in these organs, connected with general excitement of the sexual system. Vogel's theory of their formation was combated by the observation, that, as the

milk containing them was either alkaline or neutral, and not acid: were there fermentation, it was argued, the evolution of lactic acid would immediately destroy the infusoria.

In the latter part of 1854, I was induced to make some researches into this important question, from the circumstance of an infant being brought to me, seven weeks old, in the most extreme state of emaciation, whose mother had the appearance of the most perfect health. The child, although merely skin and bone, was healthy and plump at birth, and on very careful examination no disease could be discovered. It had never been satisfied with the large amount of milk it received; but was ravenous, and had to be spoon-fed besides. This was a first child, and the mother seemed the *beau-ideal* of an excellent and healthy nurse. The child had no diarrhœa, but the most profuse diaphoresis and diuresis had worn it to a shadow.

What was the cause of this? An examination of the milk, carefully made, at once furnished the clue. It was rich in cream, neutral, sp. gr. 1032, and showed the presence of a large quantity of sugar. So far it seemed normal. Examined under the microscope with a high power 7 hours after withdrawal, it revealed myriads of living animalcules, those indeed known as *vibrio baculus*, but which I venture to change to *vibrio lactis* as more appropriate. These were, to my mind, unmistakeably the result of fermentation of the saccharine element in the milk, and might be owing to the large quantity of sugar present; but whether occurring in or out of the breast I had yet to determine. The next day I examined the milk as drawn from the breast, and found the *vibriones* present as before, incontestibly proving that the fermentation took place within the gland, as I had previously believed. There was an absence of mammary congestion and heat, but much sexual excitement, which it became necessary to control by moral and suitable medical treatment.

I did not altogether order the child to be weaned, but prescribed a diet with plenty of good cow's milk, and occasionally the mother's milk, which it did not seem prudent to stop altogether. From this time the improvement began; the extreme action of the skin and kidneys ceased, the secretions became normal; and in a few weeks the child had become fat and hearty, and after a time was wholly weaned. The mother's condition also improved; but the milk always remained neutral, its specific gravity varying from 1032 to 1035, very rich in sugar, and containing the animalcules for some weeks. The richness of the milk became less as the child was gradually weaned, when it assumed a bluish tint. As quantities of it

were withdrawn artificially, I had many opportunities of examining it with other specimens of milk; and the general result of my experiments went to prove the presence of a large amount of sugar, and that it turned sour much sooner than cows' or healthy human milk.

From 1854 up to the present time I have examined many hundreds of specimens of human milk, chemically and microscopically, and have occasionally found two genera of animalcules to be present, in that secreted from the glands of those whose general health was disordered from various causes during lactation, or where the process of lactation itself was unusually prolonged, or again where the quantity secreted was small and wholly insufficient to satisfy the wants of the infant. In some persons, at an early period of lactation, wherein the supply of milk was abundant and rich, and where the constitutional symptoms were similar to those mentioned in the case I have briefly referred to, the two varieties of animalcules were present, but not in the same individual. These creatures consisted *firstly* of the true *vibrio lactis*, as I shall call it, resembling little rod or minute hair-shaped bodies, and similar to those found in some of the other fluids of the body, a minute description of which it is not necessary that I should here go into; and *secondly* of monads, which I have found to be far more frequent and common than vibriones, their diameter varying in different specimens of milk, but ranging from the 3,000th to the 5,000th parts of an inch. I am not aware whether they have been before discovered in milk, at any rate I purpose calling them *Monas lactis*.

It would be foreign to the scope of this paper to enter into the detail of any cases; but I may mention, that these animalcules were noticed at all periods from a few days to upwards of 12 months, of the period of lactation, and the colour of the milk varied from bluish to white, pure white, and yellowish, the specific gravity ranging from 1,024 to 1,035, and almost invariably alkaline or neutral, a fact of some significance. The quantity of cream was rich in many, middling in some, and but seldom poor, unless after prolonged lactation. Of the two varieties of animalcules, the monads were much more frequently met with than the vibriones.

The children as a rule are badly nourished, and at the early months, are often skin and bone, resembling *little old men*, and die soon of inanition, unless an early resort be had to other food besides the mother's milk. Curiously enough, the mothers, at this early period, have the appearance of good health; their milk is rich in its natural constituents, especially the sugar;

but the latter seems to have been influenced through the agency of the nervous system, in fermenting to a certain extent, and giving rise to the generation of these animalcules. It is not these little bodies that disagree with the child; but owing to the nervous, or as I may perhaps conveniently call it—the galvanic shock—which the milk has received as it is secreted, through the influence of the uterine nervous system, it becomes useless as a nutritive fluid, and does not undergo the natural changes in the child during the processes of assimilation. This is the view I would venture to offer of its disagreement.

Now, with regard to the fermentation within the breast, it may be observed, that this process seems, to my mind, to be a fact that cannot be disputed nor ignored by any of the objections which have been brought forward elsewhere against it. This act I would place in the sugar itself, as, indeed, the only element likely to produce it; and I hold the opinion that the act of fermentation of the sugar, need not necessarily give rise to the formation of lactic acid. Admitting that it may even do so, the lactic acid thus formed would exist in too small a quantity to produce an acid reaction in comparatively such a large quantity of milk, in some cases. And as the milk has never been acid in any single instance, in which I have had the opportunity of examining it, I infer, that there must be either no lactic acid at all, or that its quantity must be exceedingly minute. And again, these animalcules are commonly found in alkaline fluids in other parts of the body, and if the evolution of lactic acid went on to any extent, they would be destroyed. In some experiments performed by Berthellot (recently detailed in the *Comptes Rendus*), he was enabled actually to produce fermentation of cane sugar in an alkaline liquor, which entirely excluded the influence of an acid. The rapidity with which the milk, containing these animalcules, is decomposed and turns sour, after its withdrawal from the breast, generating a large quantity of lactic acid, is an additional proof of fermentation having commenced within this gland, which at first gives rise to their vitality, and then their destruction by the subsequent chemical changes which the sugar undergoes, in which lactic acid now plays an important part.

The process of fermentation within the body, and I may also say out of it, is as yet so little understood, that I may be excused if a more rational explanation has not been afforded for its occurrence in the breast than that I have ventured to give. The glucogenic function plays such an important part in the animal economy, especially in relation to histological phenomena, that it seems to be the one at fault in this con-

dition of the breast. To use the words of Bernard, " as soon as it fails to be supplied, epithelium is no longer produced; various diseases are the immediate result; and, under similar circumstances, life is inevitably brought to a close." *

It has occurred to me that these animalcules may be generated from the surface of the mucous membrane of the lactiferous tubes, by the fermentation of the sugar at the moment of its secretion from the blood, and hence the explanation of the large number, of monads especially, found in the milk thus affected, they are sometimes adherent and clustered around the milk globules. The necessary connection which subsists between the mammary glands and uterine organs in the body, satisfactorily explains the existing influence of the latter upon the former, in producing much heat and internal congestion through reflex nervous agency; these glands become morbidly irritated as it were, and cause slight fever. But this is usually at the early periods of lactation only, although I have seen it in prolonged lactation, when not unfrequently the vision becomes impaired, and in one female thus affected, a shade of yellow was seen by one eye, and green by the other.

In conclusion it remains for me to add, that when an infant is observed to become extremely emaciated, accompanied by copious exudations from the skin, intestinal mucous membrane or renal organs, separately or combined, and if the mother is apparently healthy, with a good supply of milk, its examination becomes a matter of urgent necessity, and if it is found to contain any infusoria, it must be gradually dispensed with, and such measures adopted as shall arrest the starvation of the child.

ON THE ACTION OF CHLOROFORM UPON THE BLOOD.

By A. Ernest Sansom, M.B., London.

Plate XIII.

IN many cases in which the inhalation of chloroform-vapour has been followed by death, the whole mass of the blood has been found, on post-mortem examination, to be very dark in colour and very fluid. Dr. Taylor says of the anæsthetic,† "It is absorbed into the blood which it darkens, as in cases of

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* Med. Times, 3 March, 1860.
† On Poisons, 2nd Edition, p. 736.

asphyxia, and is thus circulated throughout the system. The blood is probably directly poisoned by it."

Of all the elements of the organism, the blood is the most powerfully and the most obviously acted on by chloroform. If, with the fresh blood received from an opened vein, a few drops of chloroform be mingled, coagulation will result in twenty seconds' time. If this be allowed to remain for some hours, instead of a soft clot, there will be found a hard mass, solid and resisting, owing to the former having contracted. The production of this change must have been the work of a very small quantity of chloroform, for the greater part of that originally used exists unmingled with the clot. Further, a small fragment of this self-same coagulum is capable of inducing a similar change in uncoagulated blood.*

So far, this was made out by M. Faure in his investigations on the nature of anæsthesia, but he seems not to have traced the changes in the ultimate elements of the blood. I will now endeavour to show that chloroform manifests a powerful action upon the blood-corpuscles.

The effect of the mingling of liquid chloroform with the blood is an almost total solution of the red-corpuscles. Under the microscope, a nearly homogeneous yellow-tinted field presents itself, with here and there only the faint outline of a red blood-corpuscle. The white corpuscles, on the other hand, appear to have been uninfluenced. If, instead of this wholesale admixture of chloroform with blood, a small drop only be exposed for a minute or two to the vapour, an identical change is found to occur. To trace the most subtle effect of feebler influences, I have used, in these investigations, frogs' blood. Placing a little, undiluted, on a glass slide, I exposed it for only about two seconds to the vapour proceeding from an open bottle of chloroform at the ordinary temperature of the air; having covered the blood with a slip of thin glass, I then examined it by the microscope. The blood-corpuscles appeared to have undergone these changes. Some were elongated, and their cell-wall puckered (Plate XIII, fig, 2): others showed a tendency to cohere, their intervening cell-walls to disappear, and their contents to coalesce (fig. 3); others, again, had been completely dissolved, leaving nothing but scattered nuclei (figs. 3, 4).

The progressive changes, therefore, on the blood-corpuscle, I believe to be the following :—

(1.) Corrugation of cell-wall; alteration of shape; coherence.

(2.) Solution of cell-wall.

* Archives Générales de Médécine, 1858, p. 641.

(3.) Coalescence of cell-contents.

To observe the effect of chloroformisation on circulating blood, I exposed the web of a frog's foot on a frog-plate under the microscope, and then sprinkled a few drops of chloroform upon the damp cloth in which the frog was wrapped.

The first change noticed in the circulation was an increase of its rapidity. In about twenty seconds the capillaries had dilated to nearly twice their normal size. Then the flow became slow, the corpuscles manifested the tendency to aggregate, and in some instances to assume that shape which chloroform promoted in them out of the body. These cohering blood-corpuscles toiled along the capillaries in an interrupted current. More chloroform being given, the tendency to cohere became greater, the current slower. Ultimately, stasis of the blood occurred (first in the larger vessels) and death.

The most noticeable changes induced by chloroform on the circulating system are therefore :—

(1.) Acceleration of the flow ;
(2.) Dilatation of the capillaries and the blood-vessels;
(3.) Alteration in shape of blood-discs and tendency to cohere ;
(4.) Stasis of the blood.

These facts have, I believe, a great influence on the theory of anæsthesia. That "narcotism is suspended oxygenation" is a doctrine receiving every day greater confirmation. I believe that the action of chloroform is directly upon the blood-corpuscle, that thereby its capability of receiving oxygen is impaired, and its faculty of stimulating the various functions of life subdued: in other words, that the phenomena of chloroformisation are due, not to the agency of a circulating poison, but to the influence of an altered blood.

ON THE OCCURRENCE OF GLUCOSURIA IN CASES OF BURN.

By WILLIAM ROBINSON HILL, M.D., EDINBURGH.

Physician to the Eastern Dispensary, Bath.

IT may be considered rather premature to publish the following observations, on the ground that they are not sufficiently extended or conclusive to found any arguments upon ; but my object in so doing is merely to make known certain facts which, as far as I am aware, have never been the subject of notice pre-

viously ; and, secondly, to indicate any inferential conclusions to which they seem to lead.

Though the condition of glucosuria has been ascertained to exist under a great variety of circumstances, the ultimate cause being in some cases ascertainable, and in others hitherto quite beyond the reach of investigation, yet I believe it has never been recorded as a result of extensive injury to the skin inflicted by the application of flame to the surface of the body, and it remains for those who have opportunities of more extended observation on this subject, either to confirm the universality of its occurrence, or to point out its incidental nature if the following cases should prove to be unique.

What led me to the discovery was the *a priori* argument, that such an injury to the cutaneous surface must check the elimination of those elements of waste which were known to be given off by the skin, and that if thus checked, this must be compensated for by an increased excretion of the same elements through some other channel or channels, and considering it most probable that the renal organs would be here called into action for the restoration of the balance in the processes of waste and regeneration, I instituted an examination of the urine in the first case of extensive injury by burning that came under my notice, which happened to be in a woman of middle age, who was severely burnt on the face, arms, breast, abdomen and thighs, the cuticle being in many places blistered and charred.

The first urine that was passed was subjected to examination,* and was found to contain no albumen ; to be of sp. gr. 1029 ; and to yield a very decided reddish-brown colour on boiling with solution of caustic potash. She died about 10 hours after I saw her, and therefore no further results were obtained from her case.

The second case was much less satisfactory, but I mention it as a corroboration of the other observations. It was a girl who was burnt only on the right arm, the back of the right shoulder, and very slightly on one knee.

Her urine when first examined was found to be of sp. gr. 1020, and yielded both with Trommer's and Moore's tests evidence of the presence of sugar, though only as a mere trace.

Three days afterwards the sp. gr. was 1024, and the presence of sugar was as distinct as at the first examination.

The third case was that of a little boy, aged 10, who was so fearfully and extensively injured, that he died within 24 hours

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* I may mention here, that the correctness of my observations in some of the examinations of urine detailed in this paper, was corroborated by my friend Dr. Carter, of Leamington, who is already known in the scientific world by his publications on a variety of chemico-physiological subjects.

after the burning took place.   In that interval I obtained portions of his urine twice.   The first specimen was 1036 sp. gr., and gave with the ordinary tests unquestionable evidence of the presence of sugar.   The second specimen which was voided a few hours afterwards was found to have increased in sp. gr. *nine* degrees, and yielded a very much deeper brown colour with the potash test, showing that the amount of sugar increased in proportion as the time elapsed for the accumulation of the waste elements in the system.

The death of this boy unfortunately prevented the case being followed out satisfactorily.

The fourth case was a middle-aged woman.   I obtained the first specimen of her urine about 10 hours after the accident. It was then of sp. gr. 1031, containing a deposit of amorphous urates and lozenge-shaped crystals of uric acid   There was no albumen present, but a faint tinge was produced by the potash test.   Some hours later the sp. gr. was 1037, and the tint on boiling with caustic potash was decidedly darker on each occasion, also the brown suboxide of copper was produced on boiling the urine with solution of sulphate of copper and liquor potassæ.

On the next day the sp. gr. was 1036, and the sugar tests yielded the same result as before.

Five days afterwards another specimen of the urine was examined; the sp. gr. was 1034, and sugar was still found to be present, but the urine contained now in addition a considerable amount of phosphates and albumen, and with the microscope epithelium and granular tube casts were discovered.   Next day the sp. gr. had fallen to 1024, but the condition of the urine was in other respects the same.   It must be mentioned that on the two last occasions the results of the sugar tests were much less distinct than in the three first specimens of urine examined.

This patient was not under my own care, and at this period I lost sight of her, so that the case is unfortunately incomplete; indeed, a much more extended series of observations is requisite before the occurrence of diabetes in cases of burn can be considered as an established fact, and before it can be pronounced to be an invariable consequence of the injury, but that sugar should have been present in all the cases above referred to, which were examined without selection, just as opportunity presented them to me, may, I think, be regarded as something more than an accidental coincidence, and justifies us now in examining the subject analytically to see if *a posteriori* reasons can be adduced in favour of this condition of the urine being connected with, if not the result of, the physical injury.

It is a note-worthy circumstance that in three of the cases

an increase in the density of the urine took place within an early period after the occurrence of the accident, and that in at least *two* of them a corresponding increase in the amount of the sugar present was made evident by a much more distinct reaction on application of the sugar tests, whilst in the fourth case which was under observation for a longer period than the others, the sugar decreased in quantity as time elapsed, with a corresponding fall in the density of the urine.

These little facts seem to point to the conclusion that the sugar being produced by the accident increases in quantity during the time that the system is increasingly feeling the effect of the injury, and that as it gradually recovers its balance the diabetic condition is on the wane.

The only two theories that have suggested themselves to my mind for the explanation of the above facts are:

I. That the mellituria is due to the shock which the nervous system must sustain under an injury so sudden and severe as an extensive cutaneous burn; or

II. That it is for the excretion of effete elements on the principle of complementary succour yielded by the organs one to another, on which ground also the idea of instituting an examination of the urine originally suggested itself to me.

With the first theory the occurrence of traumatic diabetes mellitus consequent upon injury to the head, 2ndly the artificial production of a diabetic condition by injury to the floor of the fourth ventricle of the brain, and 3rdly the production of glucosuria by poisoning an animal with curara, seem to coincide. In the second of these examples a portion of the nervous system is irritated and excited, and in the third the nervous system is paralysed, and thus the formation of sugar is attributed to two conditions of that system, which though they may be allied to one another are not identical, whereas by applying the principle I am attempting to bring forward the cause is found in each case to be the same; viz., deficient excretion of carbon and hydrogen; in the curara experiment from paralysis of the respiratory organs, (as artificial respiration has to be kept up, and we may well presume that that is not adequate to the purposes of life), and in the experiment on the fourth ventricle, Bernard has particularly noted that the injury must be inflicted near the origin of the pneumogastric nerves, which accords with other experiments to show that stimuli conveyed through these nerves causes the respiration to become slower.

It might be argued against these explanations that in the majority of diseases characterised by embarrassment of respiration there is no appearance of glucosuria, to which a satisfactory

response will be found, in remembering that first in these cases the skin or other organs may be called into increased action, and that the process of sugar formation is reserved only for extreme cases requiring a rapid removal of a great excess of carbon and hydrogen present in the circulation; and secondly that in diseases the amount of carbon and hydrogen ingested is diminished, and that the combination of carboniferous elements with oxygen proceeds only in proportion to the requirements of the system for the purposes of respiration and calorification.

It appears to me further that as the principal compounds excreted by the skin are carbonic acid and water, of which carbon and hydrogen are waste elements produced by the interchange of tissue components, and as such an extensive area as the cutaneous surface has been provided in addition to the pulmonary organs for the elimination of these elements, that of necessity, an extensive and sudden destruction of skin must diminish the amount of carbon and hydrogen eliminated in a given time, and that according to the usual laws of compensation these effete elements escape by the kidneys as the readiest channel, and that, in the form of sugar which is composed entirely of carbon and hydrogen in combination with oxygen.

This theory is in accordance with the universally recognised compensating function of the kidney under other circumstances, e. g. in the excretion of water which varies in amount according to the activity or quiescence of the skin in its office of transpiration; also in the "brick-dust" sediment observed when the waste of nitrogenous tissues exceeds the capability of the kidneys, lungs, and skin to remove the elements under normal conditions (i.e. in solution), or when from any cause the latter organs are checked in their excretion of the normal amount of ammonia and other nitrogenised products.

This fact is shortly expressed by Dr. Golding Bird, in the following words, " As a general rule, whenever the functions of the skin are impaired, where a due amount of secretion is not exhaled from the surface, an excess of nitrogen is retained in the blood, and ultimately separated by the kidney in the form of urate of ammonia, or perhaps urea;" and in the case in question I am but applying the same principle to some of the other elements excreted by the skin.

Supposing, then, that this explanation of facts is correct, it will naturally be asked how far may this theory be applied to the disease known as diabetes mellitus. I do not mean to assert that in this case the presence of sugar in the urine is due to obstruction of the excretory channels of the skin, but it is worthy of notice that a dry and non-transpiring skin is a con-

comitant condition of diabetes, and the gradual wasting of the body and disappearance of the fatty tissues allow of a fair supposition that a larger proportion of effete carbonized elements enter into the blood than can be removed by the ordinary channels, which are provided to effect this object only under the normal conditions, and hence a third channel is pressed into the service and fulfils the requirement of removing the extra amount of carbon and hydrogen in the form of sugar.

By what chemical or vital process the sugar is formed, or why the elements in question enter into that particular chemical combination does not form a part of my subject, the object of this communication being merely to propound the probable reason of its appearance under certain circumstances, and to offer objections to any theories that seem to militate against it ; neither do I undertake to say, whether the liver possesses the glucogenic function which has been ascribed to it, and which it might do quite compatibly with anything that I have brought forward, though I should not be inclined to suppose that the suspension of this power during life, which seems to be an established fact by the experiments of Dr. Pavy, is to be explained by supposing that it is prevented by the influence of the nervous system, but I would rather account for it by presuming, that in a normal condition of the body the formation of sugar is not needed, and therefore is in abeyance, only to be brought into action when required to relieve the system of a super abundance of noxious elements.

Another argument in favour of the above theory being applied to the diseased condition of diabetes mellitus may be deduced from the circumstances connected with the therapeutics of the complaint.

1st. It is found to be beneficial to debar the patient as much as possible from all articles of diet containing starch and analogous carbonised substances, thereby reducing the amount of sugar excreted because the elements carbon and hydrogen are introduced into the body in diminished quantity.

2nd. Benefit is often derived from the administration of cod liver oil, another substance rich in carbon and hydrogen, and hence replacing the excessive waste of the carbonised tissues.

Why the administration of one carboniferous substance should be found to be deleterious ; whilst another is used as a remedial agent may appear anomalous, but that it is so is a tolerably well-established fact, and its explanation will probably be found in the digestive functions, as it can be well understood that from the one substance a compound may be formed capable of being assimilated, and of forming fatty tissues, whereas from

the starchy substances it may be supposed that the carbon and hydrogen in diabetic cases enter into the blood only in such a condition that they remain there unassimilable and as effete matters to be removed only by being converted into sugar.

On these grounds the indications for the treatment of diabetes are to be sought mainly in the direction of ascertaining what are the best means of arresting the continued waste of the carbonised tissues, and what the appropriate remedies for correcting the depraved powers of assimilation.

In conclusion I will refer shortly to some of Dr. Pavy's experiments which seem to support my theory.

1st. Dr. Pavy has proved that sugar is not normally present in the blood of the right side of the heart, but that it is the result of a process coming into action at some period subsequent to the disturbance of the normal balance of the respiration and circulation.

2nd. He has shown by experiment that diabetic urine may be produced by causing animals to undergo a certain amount of struggling with embarrassment of respiration for some time previous to death, from which it would appear that the sugar is produced either by excess of waste of carbon and hydrogen beyond the natural capabilities for its removal, or by its excretion from the lungs being impeded.

The former may have doubtless some effect, but I believe that the latter is essential inasmuch as excess of muscular exertion is not known to be productive of a diabetic condition under ordinary circumstances; and the fact of sugar being produced in the hepatic veins as a post-mortem phenomenon may be explained by supposing that the carbon and hydrogen in circulation at the moment of death cannot be excreted under normal conditions because the respiratory function ceases as a rule before the circulation, and hence the carbon and hydrogen are by this compensating process thrown into the form of sugar for the purpose of ready removal.

The notions brought forward here will perchance be regarded as crude and unfounded; but the facts stated at the commencement of the paper still remain, and are worthy of further consideration as they may be of assistance in the elaboration of other theories of gluco-genesis.

ON THE STRUCTURE OF TISSUES, WITH SOME OBSERVATIONS ON THEIR GROWTH, NUTRITION, AND DECAY.

By LIONEL S. BEALE, M.B., F.R.S.

I.—ON THE STRUCTURE OF SOME OF THE SIMPLEST LIVING BEINGS, AND OF THE CHANGES WHICH OCCUR DURING THEIR LIFE.

Of the method of investigation, and of the conditions required for examining moist structures with very high magnifying powers. Of the appearance of inanimate particles under very high powers. Of the appearance of the smallest visible living particles under very high powers. Of the growth and multiplication of the living particles which have appeared in water in which dead animal or vegetable matter had been placed. Living contrasted with the lifeless particles. Origin of the living particles. Of the changes occurring in mildew during its growth. The plant composed of two structures having very different properties.—1. Germinal matter; 2. Formed tissue. Of the growth of the component particles of germinal matter. On the formed tissue or outer membrane. Recapitulation. Of the formation of secondary deposits. Result of the unrestrained growth of germinal matter. Of the different powers possessed by elementary parts which have all descended from one. The growth of elementary parts contrasted with the deposition of crystals. Of the spherical particles of germinal matter; composition, motion, structure, and arrangement.

PLATE XII.

OF THE METHOD OF INVESTIGATION, AND OF THE CONDITIONS REQUIRED FOR EXAMINING MOIST STRUCTURES WITH VERY HIGH MAGNIFYING POWERS.

MANY experiments have convinced me that it is not possible to trace the various changes occurring in the structure of tissues during their growth, or to investigate with any success the minute anatomy of textures, unless they are saturated, almost immediately after the death of the animal, with some preservative fluid which will effectually prevent the

occurrence of those changes in the soft parts which commence as soon as life is extinct.

The solution employed must also possess the property of rendering more or less opaque those delicate tissues which are so transparent as to be almost or quite invisible under ordinary circumstances. The medium in which the specimen is subjected to examination must possess a certain degree of refractive power, and its composition must be such, that its refraction can be readily increased or diminished, according to the nature of the specimen under examination.

The changes taking place in the structure of tissues during their growth require for their investigation the highest magnifying powers which can be obtained. These, however, will be quite useless, unless extremely thin sections of the tissue can be made. The process of drying, in ordinary use, has been found to be inadmissible in these investigations; because the relations of the delicate structures are so altered, and their appearances so modified, that they cannot be recognized with certainty. Other plans have therefore been tried. Soaking in glycerine has been found to succeed best.

I have found it necessary to modify the fluids employed in different cases, but glycerine is the basis of them all, and acids, especially chromic acid, and alkalies, have been employed according to the results of experiment. The smaller structures have been merely soaked in the fluid; but it was found quite impossible to obtain satisfactory results by employing this plan for investigations on the tissues of the higher animals. Experience has proved, that the injection of the preservative fluid into the vessels of the animal immediately after death, will alone enable us to fulfil the required conditions, and in all the preparations I have made, the injecting fluid has been coloured with Prussian blue, so that the capillaries are in all cases injected with a transparent injection. Soaking in an ammoniacal solution of carmine and other colouring matters was found to be necessary for instituting comparisons between the elementary parts of the different tissues.

I have succeeded in carrying out these plans in such a manner that I have been enabled to obtain exceedingly thin sections of injected animal tissues without previously drying them, and to subject them to examination under higher powers than have been employed previously. The object-glass I have used is the 1–26th of an inch, made for me by Messrs. Powell and Lealand. It magnifies with the low eye-piece nearly 1,800 diameters. The results of my observations have led me to draw conclusions with reference to the structure,

development, and growth of tissues, which differ in many important particulars from the opinions entertained by those who have studied these subjects.

I have been led to take a view of the nature of the different parts of the so-called cell,—animal and vegetable,—of its origin, of its mode of growth, and of its powers and properties, which differs entirely, as far as I can learn, from that of any previous observer. The results of these researches have also compelled me to differ in important particulars from the modern views of nutrition and growth, and to dissent from the general opinion of the nature and mode of formation of the so-called intercellular substance.

I am very desirous of expressing the results of my researches into these very complicated and difficult questions as simply as possible; and I propose to relate here the conclusions at which I have arrived. I shall venture to omit calling the reader's attention to each separate point in which I agree with, or differ from, those who have written on the same subject before me; because, by adopting this course, I shall be able to express myself more clearly and very much more briefly.*

It is only right that I should state, that the doctrine which I have been led to propose has resulted simply from observation, and from watching the different appearances presented by the same textures at various periods of growth, and comparing the structure of tissues, fulfilling nearly the same functions in different classes of animals and plants. I have also learned much from instituting careful comparisons between healthy and diseased tissues.

I propose, in the first place, to state generally the results of my observations, and then to consider more in detail the conclusions I have arrived at with reference to the successive changes taking place during the life of some of the most important tissues of the human body.

It will, I think, enable me to express my views more clearly if I refer, in the first place, to the appearances presented in the examination of the most minute particles of inanimate matter, and compare them with those observed in the most minute living particles which we are able to see. Next it will be necessary to study carefully the changes which may be observed during the growth of the simplest living organisms.

* The general views now held, are given in Professor Kölliker's "Manual of Microscopic Anatomy," Parker and Son. The reader is also referred to Mr. Huxley's Article on "The Cell Theory," British and Foreign Medico-Chirurgical Review, October, 1853.

OF THE APPEARANCE OF INANIMATE PARTICLES UNDER VERY HIGH POWERS.

Let any inanimate matter, organic or inorganic, in a state of very minute subdivision, be suspended in a little water, and placed upon a glass slide. After it has been covered with a thin glass cover, it may be examined in the microscope with a power of two hundred diameters. A vast number of very small particles will be seen, the size of which could not be ascertained, nor the form described. If the preparation be attentively watched, it will be noticed that every minute particle is in motion —tremulous to-and-fro movements are perpetually occurring. Next, let the same specimen be examined with the highest power (1700 diameters), and the same general phenomena will still be observed as before, but more clearly. All that we learn by increasing the power seems to be that particles before invisible from their minuteness, have been brought into view, and the movements are seen more distinctly. The smallest particles exhibit no form, and the larger ones seem to consist of mere aggregations or collections of the smallest; and these by further subdivision could be resolved into their constituent particles. How far the detection of smaller and still smaller particles could be carried, it is difficult to judge; but it is quite certain that the instruments and means of investigation at present at our command do not enable us to see by very many degrees the smallest particles into which masses of matter may be divided.

OF THE APPEARANCE OF THE SMALLEST LIVING ORGANISMS UNDER VERY HIGH POWERS.

Let a small piece of any dead animal or vegetable matter be placed with a drop of clear water upon another glass slide, covered lightly with a piece of thin glass, so that it may be exposed to air and light in a moderate temperature. Under the highest powers, the water appears as clear as the glass, and nothing is observed but the piece of animal or vegetable matter which has been placed there. Leave the specimen in a light warm place for a few hours and examine it again. The water is no longer perfectly clear. It appears to the unaided eye slightly turbid, and, upon microscopical examination, this turbidity is seen to depend upon the presence of millions of minute particles which have made their appearance since the preparation was first examined. These little bodies exhibit movements very like those of the inorganic particles before described.

Now let a higher power be employed, and immediately many more particles come into view. The highest magnifying power shows yet more minute specks, and we may feel sure that even now we can form only a very imperfect idea of the number of the particles actually existing in the drop of water under examination.

Let the observer add a little gum or glycerine to each preparation, and the movements are nearly, if not completely, stopped in both instances. What differences then can be discerned in the two preparations? We know how the one specimen was obtained. The particles in the other appeared in clear water. In both preparations the particles are too minute for measurement. In both, movements are observed. In both, these movements are stopped, or nearly so, by the same circumstances. The particles on the first slide examined, appeared, perhaps, darker than those on the other. The last, have a translucent appearance which is difficult to describe; but the character in which they principally differ in appearance from the others is their form, which is spherical or oval, and the smallest particles which can be seen appear to be very minute spherules.

The fluid on the first slide contains particles of inanimate material. The other contains minute particles which have appeared under circumstances which we know favour the development of living organisms. Let the slides be again set aside for some hours longer, and then let them be examined with the highest power.

The inanimate particles have scarcely altered. Several may have become aggregated together here and there, and thus some appear a little larger than before; but careful pressure upon the thin glass immediately causes their separation. The particles have certainly not increased in number.

OF THE GROWTH AND MULTIPLICATION OF THE LIVING PARTICLES WHICH HAVE MADE THEIR APPEARANCE IN THE FLUID.

Now let the particles which have appeared in the fluid be again subjected to examination. They, too, exhibit the same general appearance, but by careful observation several new points will certainly be noticed. Many of the particles are distinctly circular, with a sharp well-defined outline, and a comparatively transparent centre,—appearances which justify the conclusion that the form of the particles is really *spherical*. These exhibit no tendency to aggregation, although several may be attached to each other, in consequence of having been produced by division. The separate ones do not attract each other, and

are not in close contact. Others have an oval or elongated form. All which are sufficiently large to be seen distinctly, exhibit a definite *form,* and the *size* of many could be measured without difficulty.

From the appearances above detailed, we should be led to suspect that the structure of the external part of each particle was different from the interior, which seems to consist of a delicate granular looking material.

Some of the particles appear in the act of dividing into two; others have formed a sort of string, in consequence of this process of subdivision having been repeated for some time in a direct line, or in opposite directions. A great many exactly resemble each other, and several are of uniform size. The particles appear to have enlarged since they were last examined, and many new ones have made their appearance. There seems to be a certain size which none exceed, but we can trace particles of various gradations of minuteness, until nothing but a mere point is visible under the highest magnifying powers. Nevertheless it is, I think, more in accordance with the results of observations in various departments of natural knowledge, to conclude that we should see many particles, more minute than the smallest now demonstrable, if our magnifying powers were more perfect, than to assume that these are the very smallest separate living particles which can exist. Even the largest particles are so small that one cannot feel sure whether the central transparent matter be perfectly clear, or whether it is composed of minute granules, or of small spherical particles.

We have now learned that the particles increase and reach a certain definite size, and multiply in number by division. Many, as I have said, are connected together to form strings; others, likewise produced by division, form little collections of a definite shape, perhaps like a cube, or of an oval form; most of the separate particles are, however, equidistant from each other and spherical. The form of the compound body, therefore, is not the same as that of its component particles.

The particles have been watched as they have passed through certain definite stages of existence. They appeared as minute specks. They grew into little spherical or oval bodies, and therefore assumed a *definite form.* Having reached a certain size they divided. Each of these grew to the same size, and the process was repeated, and these phenomena seem to have recurred again and again, until every part of the fluid is occupied with the continually multiplying particles. The multiplication throughout has taken place in order, and with perfect regularity.

A LIVING CONTRASTED WITH A LIFELESS PARTICLE.

Now let us contrast one of these particles which has appeared in the fluid with one of the inorganic particles, which we placed in the water. The former has not ceased to undergo change. How small it was when it first appeared cannot be ascertained by our instruments, but we know that it gradually became larger, until, by being increased to eighteen hundred times its real dimensions, it became visible to our eyesight as a very minute speck. It continued to increase until it reached a certain size, and then, by its division, gave origin to another like itself, and this process continued until countless millions of particles, closely resembling each other, have resulted from the changes which commenced in the scarcely visible speck but a few hours ago. These phenomena are characteristic of *living beings*, and no changes at all resembling them have ever been observed in inanimate matter. The particles which have appeared are *living*.

The particles placed by us in the water exhibit no definite form or size, and they have undergone no appreciable alteration since they were first examined. They are *not living*.

ORIGIN OF THE LIVING PARTICLES.

There are few questions more interesting than that which relates to the origin of the living particles in the fluid in which a little dead animal or vegetable matter had been placed. We are only able to study, by actual observation, the latter part of the history of the life of these organisms. We have seen how they *increase in number*, but, as there is reason to believe that, from the imperfection of our instruments, we are not able to discover the original particles until they have existed for some time, and grown to a certain size, we cannot admit the impossibility (in the present day) of actually seeing the germs of the first series of particles, as an argument against this view of their origin; while, on the other hand, the weight of evidence in favour of the doctrine that *every living particle, comes from a pre-existing living particle*, is so irresistible that we are fully justified in assuming the existence of exceedingly minute particles, protected from the action of external destructive agents which spring into active vitality whenever the conditions favourable to their development should be present.

The particles which result from the development of the germs probably divide and subdivide and multiply enormously, perhaps long ere they are large enough to be seen by us. Of all the separate living particles thus formed, probably very few

grow to any size, and millions die long before they are protected by any investment. This covering, however, once formed, the increase of the particles goes on within it, and the mass attains a comparatively large size before it divides. Each one particle may be regarded as a centre from which growth may proceed infinitely; and the sacrifice of millions, so far from tending to the destruction of the race, probably brings about the conditions by which alone any of the organisms could attain to their perfect development.

It is worthy of remark that after the smallest and simplest forms have existed for some time in the water they are succeeded by larger and more complex ones, and these in their turn disappear as higher organisms arise. How far the latter may be mere modifications of the simpler structures, or new species arising from special germs, the conditions for whose development have been supplied by the former series, cannot be discussed in this paper. It is certain that when the vitality of one living structure becomes depressed another will grow at its expense, and whole generations of some of the simplest organisms in passing through the various stages of their existence seem to bring about the conditions necessary for the development of beings higher in the scale of creation.

OF THE CHANGES OCCURRING IN MILDEW DURING ITS GROWTH.

The bodies we have been examining are so minute that it is not possible to investigate their internal structure. Even under a power of 1,700 diameters they appear almost transparent and exhibit no definite internal structure; yet there is good reason for believing that they really consist of aggregations of numerous smaller particles which are still compound.

Ordinary mildew is a structure closely allied to that which we have seen developed in the fluid, and as it can be very easily obtained, and the changes taking place in its growth, watched, it is well suited for study.

Each little spore may be considered as representing one of the elementary parts (cells) of the tissues of more complex organisms; and it is therefore very necessary to study the nature of the changes which occur, for in so simple a structure we shall be more likely to investigate these changes with success than by attempting at once to examine more complicated organisms. (Plate XII, fig. 1a.)

The little spherical spores of this simple vegetable growth are exceedingly light, and are carried everywhere by gentle currents of air. When they happen to fall upon any moist surface, where the conditions necessary for their development

are present, they begin to grow, and a vast amount of vegetable tissue is very rapidly formed. The nature of the material in which the spore grows, and other conditions, influence the rapidity of growth, and modify to some extent the characters of the fungus. It is probable that many forms which were regarded as different species spring from the same plant, and that the altered characters are due to the different conditions under which growth has taken place.

As far as I have been able to ascertain, the changes which occur in the spore about to germinate are as follows:—The outer membrane becomes permeated by the moisture and swells up. Some of the particles in the interior, which are seen to be spherical, seem to advance and to come into very close contact with the internal surface of the moist membrane. By increasing the magnifying power, other particles which appeared as mere points, are proved to be spherical also. (Plate XII, fig. 1*a*, *b*.) The spherical particles can be seen to increase in size and multiply by division. This process is continually repeated until the external membrane is distended by the increase of its contents. The following changes may now occur :—

1. The whole mass may divide, and thus two similar structures are formed from the one,—a mode of increase very common in some of the lowest fungi.

2. The principal increase of the particles may be determined more particularly to one spot. An outgrowth occurs at this point instead of the whole mass dividing into two equal portions. This outgrowth consists of soft granular matter within, protected by a transparent covering. It continues to grow in the form of a tube, the direction which it takes being determined by several circumstances which cannot be considered here. At short intervals the granular living mass within divides transversely, and the tube is at length separated into several portions by partitions. Each portion incloses a part of the interior mass, which possesses the same powers of growth as the rest. (Plate XII, fig. 1*k*.)

3. Little pores, which extend nearly through the outer membrane, become enlarged as it is stretched, and a small quantity of the increasing granular living mass within advances and carries before it a very thin layer of the membrane, and rapidly extends into the surrounding medium. (Plate XII, fig. 1*d, l, m, n*.)

In either of these cases the outer membrane is comparatively firm and transparent, while the matter within retains the characters it originally possessed. A tube, which is often exceedingly thin

when it begins to grow, is formed. This tube contains living granular material, which increases in the same manner as that in the spore. It gradually extends, apparently in consequence of the rapid increase of its contents. Branches are formed at short distances, and it soon becomes evident that a large amount of the inanimate matter which surrounds it passes through the walls of the tube into its interior, and becomes a part of the living tissue of the plant. After a time, some portions increase in an upward direction, and grow into the air. Upon the summit of these aerial stems, little oval capsules are formed. These also contain living granular material, resembling that in other parts of the plant. From this the spores, which are provided with a thick external protective covering, are formed, and these pass from the oval capsules one after another. (Plate XII, fig. 1, *p, r*.)

I might dwell much longer on the early changes occurring during the germination of the spore, and especially on the various appearances presented by the plant when the conditions under which it grows are modified; but I have only alluded briefly to these phenomena here, in order to show that the matter which is undergoing active changes is enclosed in a transparent *passive material, permeable to fluids,* which prevents the destruction, and, by its passive properties, ministers to the preservation, of the more easily destructible mass which it incloses, while, at the same time, the tendency of the living matter to increase is moderated and restrained within due limits. Through the pores in this membrane soluble materials are continually passing in both directions under the influence of constant currents which are determined by the active changes occurring in the living particles of which the granular mass within is composed.

The power of absorbing and appropriating certain substances which the internal granular matter possesses, may be destroyed without any recognizable change being produced in the external envelope. In this case the granular matter no longer fills the entire cavity, nor is it uniformly diffused through the space. It has ceased to be in contact with the inner surface of the membrane, and often collects together in one part. Its component particles have lost their spherical appearance. Many seem to have run together and coalesced. Little collections of highly refracting particles are seen in various places in the interior. Part of the mass seems to have become liquefied, and thus altered, with much of the fluid contents, has passed through the membrane, which, in consequence, is found to be flaccid and collapsed. (Plate XII, fig. 1*n*.)

The passive protective covering, on the other hand, seems

to have resisted the action of the conditions which destroyed the active matter within.   From these observations, I think we are justified in coming to the following conclusions with reference to the structure of the mildew :—

1. Within is a *mass having a granular appearance, but really composed of spherical particles*, varying in size, and themselves consisting of smaller particles which, there is reason to believe, are also spherical.   Under certain conditions these have the power of attracting towards them certain substances, which become altered in composition, and become imbued with the same active powers which they possess.   The intervals between these spherical particles is occupied by a fluid of complex composition from which the matter to be animated is selected, and into which substances resulting from waste are poured.   Having reached a certain size, each particle divides, and every one is the seat of perpetual and complicated changes.   The order in which these changes occur is fixed and definite.   They may be suddenly arrested by various external conditions, in which case they cannot recommence in the same particles.   The particles are, in fact, completely altered in composition, and the wonderful properties which they possessed when active are no longer manifested.

The component particles of each spherule, there is reason to believe, pass outwards in a definite order, and when the mass is growing quickly their place is rapidly occupied by new particles, which begin their life in the central part of each spherical particle.

This living material, which appears granular when examined by moderately high powers, but exhibits minute spherical particles under the highest magnifying powers, exists in all living beings.   It is always coloured by carmine and some other alkaline colouring matters, while the surrounding passive material is not coloured at all, or only very slightly tinted.   It is very abundant in embryonic tissues, and exists in much larger quantity in the tissues of the adult than most observers would, I think, be disposed to admit.   It is this matter alone which is concerned in the growth and regeneration of all tissues, and in some of the most important changes in disease.   From it all tissues at all periods of life are formed.   I, therefore, propose to call it *germinal matter*—a term which expresses its general properties without involving any special theory with reference to its exact nature.   This germinal matter is the seat of all the active vital changes which occur in living beings.   It is *living matter*.   (Plate XII, figs. 1, 2, 3.)

2. *An external material*, transparent, firm, possessing per-

manent characters, permeable to fluids in both directions, and often containing visible pores, but not undergoing any active change. This has been *formed*. The matter of which it is composed has arrived at the last of the series of changes through which every particle of the living plant must pass. This passive matter once consisted of particles which possessed active properties similar to those which it now incloses. This is *formed material,* or the *formed tissue* of the plant.

Germinal matter is not one thing for one office, and *formed material* another substance for another purpose, as the different parts of the cell and intercellular substance are now considered ; but the formed material was once germinal matter, and if the elementary part live long enough and be supplied with nutrient material, the germinal matter will, in great part, become *formed material.* These are different states through which living matter passes. The whole of the germinal matter of an elementary part never can become *formed material,* because after the latter has increased to a certain thickness, the germinal matter within will cease to be supplied with nutriment, and it will die. One of the large germinating spores of mildew, for instance, may die if the thickness of the external envelope increases beyond a certain point without the formation of an offshoot, and what we consider death from old age, in all elementary parts, seems to depend upon the gradually increased thickness of the *formed material.* The growth of the germinal matter is prevented by the membrane which invests it becoming too thick to be permeable to fluids, and unless this outer membrane be removed at one point, or a fissure formed in it, the living mass within, after the lapse of some time, must die. At *o,* fig. 1 Plate XII, a mass is represented, with a very thick outer membrane, from the upper end of which an outgrowth has occurred. At *e* the uniform formation of successive layers is seen in an oval mass.

THE OLDEST PART OF MILDEW.

The smallest growing particles which made their appearance in the water in which the dead animal or vegetable matter had been placed were spherical, and the particles of which the soft material in mildew is composed, are also spherical. Let us now consider how each one of these spherical particles increases in size. Every part of each cannot be of precisely the same age, seeing that it has been demonstrated that a gradual increase of size has occurred. Which then is the oldest portion, and which was but a moment ago inanimate matter ?

That the external envelope of a growing particle is not

increased in thickness by the deposition of new matter on the outside is proved by several facts. In many cases the external envelope increases in thickness while the diameter of the whole mass remains the same. Very frequently the external membrane is cracked on its outer surface, like the bark of a tree, evidently from the increased bulk of its contents. (Plate XII, fig. 1, *e, o*). In many algæ, little plants are seen attached to the outer surface of the external envelope and remain growing as this expands in consequence of the increase of the matter within. (Plate XII, fig, 2, *a, b*). Many other facts might be advanced in favour of this view, but the above are sufficient. The outer part of the formed material is, therefore, the oldest; while the layer in immediate contact with the germinal matter was the last formed, and has just passed from the *state of germinal matter* into that of *formed material*. Of each component particle of germinal matter, the oldest part is outside, while the matter which has only recently become living is situated in the central portion.

OF THE GROWTH OF THE COMPONENT PARTICLES OF GERMINAL MATTER.

The conclusion is therefore arrived at that the outer part of each of the spherical particles of mildew is older than the more central portion, and that the inanimate matter about to become living must pass inwards amongst the older particles of which the external part of each little spherule is composed, and in the interior acquires those wonderful powers with which the particles are endowed, and which were derived from similar particles which existed before them, and these form their progenitors, and so on, from the beginning. The particles after they have become living, pass through definite stages of existence, and move in a determinate direction from the centre towards the circumference. This motion in a definite direction exists in all living bodies, which are in a state of vital activity, but its rapidity varies in different cases.

The particles possess for a definite period of their existence the property of communicating their powers to inanimate matter, but at last they cease to divide and cease to animate new particles, and undergo changes in structure, composition, and properties.

This tendency to divide is very remarkable, and probably is the result of the force which determines the motion of the particles from centre to circumference.

ON THE FORMED MATERIAL OR OUTER MEMBRANE.

As the particles in the interior increase, the membrane which contains them expands, and is thickened by the accumulation on its inner surface, of matter which has passed through the various stages of active existence, and has now become incorporated into a nearly homogeneous tissue—which cannot multiply itself,—which is not affected by conditions which would have destroyed the particles during their active stages of existence,—and therefore serves the part of a protective covering to the matter within. This external material exhibits a certain form which appears to be determined in part by the inherent properties of the living particles, and in part by the action of external forces. It is permeable to fluids, and gases in both directions. When very thick, visible pores may be demonstrated in it, but when thin, no orifices can be seen. This membrane or *formed material* was at one time in the state of *germinal matter*. By its physical properties it protects from destruction the particles which are passing through those various stages of being which will end in the increase of the formed material. This membrane may be increased by the deposition of matter on its inner surface if it become stretched, but this is not dependent upon any vital properties of the membrane itself. It no longer possesses active properties. In some cases it has been noticed that a spore of mildew may attain a considerable size without undergoing division, and without the formation of any bud. The original envelope as it expands seems to be strengthened by the deposit of new matter on its inner surface interstitially, while the outer portion cracks in various places and becomes ragged. The spherical particles within increase and divide, and then the interior becomes occupied with a number of spherical particles exactly resembling the whole mass at an earlier period of its life. Each one of these may undergo further division, and the capsule may at length become so enlarged that unless we had actually traced the changes through which it had passed, we should not believe that it ever had been the envelope of so small and simple a structure. (Plate XII, fig. 1.)

Every one of these little particles may be regarded as an independent centre, and capable of producing similar particles infinitely. If set free, each soon increases in size, and passes through the various stages of growth to which I have already adverted.

RECAPITULATION OF THE CHANGES OBSERVED DURING THE GROWTH OF MILDEW.

In the first place, the dry membrane which protects the living matter within the spore swells up, in consequence of the absorption of water, just as a piece of gelatine or other permeable inanimate matter would become softened under similar circumstances.

Next some of the little spherical masses of living matter nearest to the moistened membrane increase in size, not by the deposition of new matter outside them, but in consequence of the passage of inanimate matter amongst the outer particles into the interior. Here the inanimate matter becomes changed in composition, form, and properties; in fact, it is endowed with the powers of the existing particles; it becomes living. The living particles, now free to move in fluid, pass in definitive order from the centre, where they became animated, outwards, and each tends to divide. The particles of which every collection is composed move outwards, preceded by particles which have been animated just before them, and succeeded by others which became living at a later period.

This tendency of the particles to move from the centre, where they became animated, depends, I think, not upon any repulsion existing between them, but upon an active power which all living particles possess, of moving in the direction indicated. It seems not improbable that the constant tendency to division results from the same power which determines these movements. The active movement outwards would, of necessity, cause currents in the fluid between the particles in the opposite direction. I believe that the intervals between the component spherical particles are occupied by a fluid, holding several substances in solution.

Each one of the spherical particles of living animal matter we have been considering, is composed of particles far more minute than itself. As it increases in size there must be incessant change in its component particles; nay, these cannot exist in precisely the same state during the smallest fraction of time that it is under examination. Some but an instant since must have entered into the composition of material dissolved in fluid which by the action of currents is carried into the interior of the living masses. By the influence of the living particles with which the inanimate matter has been brought into contact it has become altered, and has acquired powers which it did not before possess. Some particles are passing through the prescribed

stages of change, and can communicate their active powers to inanimate particles, while others are comparatively old, and have perhaps gone through in definite order numerous active phases of being, and are about to lose their vital activity.

Having passed through the stages of their existence, the particles lose their active powers. They no longer divide, and they cease to move except under the influence of forces independent of them. Many coalesce, forming in the mildew a structure of greater or less firmness and power of resistance, capable of being softened by moisture and dried by exposure to air, and subsequently remoistened without alteration of its properties; permeable in both directions to fluids and gases, capable of being stretched, of definite chemical composition, possessing important physical properties, but destitute of any inherent active powers whatever. The properties and composition of this inactive material thus formed are peculiar, and wonderfully different from those of the inanimate matter ere it became living.

The changes which end in the production of this *formed material* are characteristic of every particle of living matter; they have been communicated to matter by pre-existing living particles, and the power may be transmitted to certain lifeless particles *infinitely*.

This *formed material* is not to be regarded as an excretion of the germinal matter, nor is it produced by any action on the pabulum which is supposed to be exerted by the nucleus, nor does it result from changes occurring in any intercellular substance, neither can it be regarded as a mere chemical product. I hold that this *formed material* was once *germinal matter*, and once possessed all the active powers which the particles of the germinal matter we see, now possess. These particles have been animated, perhaps, long since those of which the *formed material* is composed commenced their existence. The peculiar properties and composition of *formed material* in different living beings and in different tissues of the same living being, depend upon the powers of the germinal matter from which it proceeded.

FORMATION OF SECONDARY DEPOSITS.

It will now be convenient to allude to certain changes which may take place in the germinal matter which have not yet been considered. Numerous illustrations may be obtained both from the vegetable and from the animal kingdom. Amongst the germinal matter of mildew, small particles may sometimes be observed, which are not coloured by carmine, and which, there-

fore, differ materially from the living germinal matter of the plant. These particles result from changes in the germinal matter and are sometimes of a nature very similar to those which end in the formation of the wall; but instead of the material being deposited on the inner surface of the membrane, and thus increasing its thickness, it is precipitated amongst the germinal matter, and sometimes accumulates to a considerable extent in the central part of the mass.

In many vegetable structures, the substance which is precipitated amongst the living particles in an insoluble form, is prevented from escaping through the formed material or membranous capsule (cell-wall) within which the germinal matter (primordial utricle) and these secondary deposits (cell contents) are found.

The escape of these substances, which are precipitated in an insoluble form, can never take place without the destruction of the whole mass, or the formation of an opening. If the products so formed were fluid, they would coalesce, and at length a mass of considerable size might be produced, and the actively growing or germinal matter would form a layer between the insoluble substance and the inner surface of the wall of the capsule, the position which the primordial utricle occupies in the vegetable cell, and the nucleus in the fat-vesicle. When these changes commence in the fat-cells, a little oil-globule is seen in the centre of a mass of germinal matter, and this might be mistaken for a nucleolus, but it is not coloured by carmine; and by carefully examining several masses in different stages of growth, its true nature can be made out.

It would seem that sometimes particles in all parts of the germinal matter rapidly grow, pass through their stages of existence, and become resolved into the same substance as that which ordinarily is applied to the thickening of the outer membrane. In this case the germinal matter will be found partly just within the membrane, and partly amongst the insoluble particles.

In the large starch-holding cells of the potatoe, the living germinal matter is seen to be in contact with the inner surface of the capsule, while the starch-granules accumulate for the most part in the centre.

There is no difficulty in finding starch-granules in every stage of formation; and careful examination will, I think, lead the observer to agree with me in the opinion that the starchy material is deposited in successive layers, so that the inmost are the first, and the outermost, the last layers which have been formed, and the deposition has taken place more

rapidly at one part than another, as shown by the different thicknesses of the layers at different parts of their circumference.   (Plate XV.)

The following very interesting point will also be observed by careful examination:—On the inner surface of some of the large capsules, starchy matter has been deposited in successive layers, producing an appearance exactly resembling that of a starch-granule, but spread out, as it were, over an extended surface. It is also important to observe that, at short intervals, there are openings in these starchy lamellæ through which nutrient material passed into the interior of the capsule. These, are more correctly described as spaces or channels, which probably are closed on their outer surface by the thin membrane of the original cell. Here the deposition of starchy matter has never taken place, and through the spaces, currents of fluid pass to the interior, and continue as long as any living matter exists within in an active state. The mode of deposition of starch can be very satisfactorily watched in these capsules (Plate XV.) In many other vegetable starch-holding cells, the lamellæ and pores above described may be seen.

According to this view, the starch-granule is formed on the same principle as a calculus, and the *deposition* of the starchy matter from solution is purely physical, but its *formation* depends upon the peculiar properties of the particles of germinal matter which select and combine substances in a special manner while passing through the various stages of their existence. At last their active powers cease, and their constituents become resolved into starch amongst other substances.

In other cases, the result of changes taking place in the germinal matter within the capsule, is the formation of crystalline or of granular deposits of different composition. In the fat-vesicle, as before stated, the germinal matter is always situated between the wall of the vesicle and the mass of fat. In the fat-vesicles of the mouse the changes can be traced from the appearance of the first minute oil-globule to the precipitation of a great number, and their coalescence to form one large globule; but this subject will be specially considered in another communication.

RESULT OF THE UNRESTRAINED GROWTH OF GERMINAL MATTER.

In the mildew the power of unlimited growth of the germinal matter is restrained within due limits by the formation

of a membrane which separates the living matter from the fluid containing the particles to be animated. The thickness of this membrane is in great measure determined by the conditions under which the germinal matter is placed. If these be favourable, the increase of the germinal matter takes place so rapidly that the quantity of *formed tissue* is very small. If, on the other hand, the conditions be unfavourable, the increase of the germinal matter occurs very slowly, and layer after layer of the outer particles of the germinal matter cease to be active and become *formed material*, and this process might continue until all the germinal matter is converted into formed tissue, were it not that before the change has proceeded so far, the formed material will become impervious, and consequently the germinal matter in the interior dies, and becomes liquefied. The liquid is often taken up, and a cavity remains in the centre of the formed material. Upon microscopical examination we find a mass of formed material, with a cavity in the centre (Plate XII, fig. 1 *n*). This cavity sometimes contains air.

The more rapidly growth takes place, the smaller will be the proportion of *formed tissue* to the germinal matter and *vice versâ*. The thinner the layer of formed material, the more readily will the matter to be animated pass into the germinal matter, which will increase in the most rapid manner. When the formed tissue is thick, nutrient material will pass in slowly and the mass will of course very slowly increase in size, or the only indication of its vitality may be the gradually increasing proportion of *formed* material to the germinal matter.

Where the external conditions are favourable, and therefore the multiplication of the particles of germinal matter rapid, a thick protecting covering would interfere with growth; but where the external circumstances are unfavourable, were it not for the formation of a thick investment, the whole of the germinal matter would of course be destroyed. If, however, the smallest particle retain its vitality, it will multiply as soon as the conditions are favourable, and from it growth may be continued infinitely.

Although, generally, the growth of germinal matter is restricted by the formed material, there are cases in which the latter is so thin that the growth becomes very rapid, and within perhaps a few hours a vast quantity of living tissue is formed. The more rapid the growth, the more evanescent is the structure formed—duration being always associated with the formation of much *formed material* of a firm not readily destructible character.

In some of the lower fungi, and in certain morbid growths,

we see the effects of this comparatively unrestrained and very rapid growth. The material to be animated passes freely through the *thin capsule* which incloses the germinal matter : division and sub-division of the spherical particles in all parts of the interior take place very rapidly, and the whole mass grows to a large size within a very short period of time. In many instances it is impossible to distinguish any external envelope at all. The particles of germinal matter in this case are imbedded and grow in a soft viscid mass, composed of formed material with the constituents for the nutrition of the living particles. Fig 3, Plate XII, *b*, represents some elementary parts from a simple fungus which grew to the size of a small pear in a single night. The larger spherical masses are seen to be composed of smaller spherules, and these of still smaller ones. *Scarcely any formed material surrounding each mass can be demonstrated in this rapidly growing structure.*

Soon, however, the growth will become so large that nutrient matter cannot be equally distributed to every part, nor can the products of disintegration be removed. The consequence is, that the whole, having attained to a very large size within a very short period of time, dies. It cannot live long because there is no provision for the transmission of new matter to each growing elementary part, and for removing effete and used-up material from it, by which alone the vitality of actively growing structures can be maintained. Channels for conveying nutrient material, and for carrying off the used-up matter, supply the conditions by which alone the processes of gradual formation and gradual decay can be carried on, except in the most minute organisms, and they are essential for the maintenance of any but the most temporary existence.

In many morbid growths in man and the higher animals, we have examples of this infinite power of growth going on unrestrained by the circumstances which retain it within due limits in the normal structure. In another communication I shall endeavour to show that cancer is the irregular unrestricted growth of a normal structure, from which the so-called morbid growth has directly descended, and that no morbid structures are to be regarded as new and specific formations, as has been especially insisted on by Virchow, but only as structures directly descended from healthy tissues, the growth of which has been modified by conditions different to those under which the changes in the normal tissues have been carried on.

OF THE DIFFERENT POWERS POSSESSED BY ELEMENTARY PARTS WHICH HAVE ALL DESCENDED FROM ONE.

In the mildew there is very slight indication of tendency to the formation of special parts or organs for the performance of special functions. Each portion of germinal matter attracts to itself and animates lifeless particles, and these, after passing through certain stages of existence, become altered in properties These changes go on in all parts of the plant in precisely the same manner. They may take place more rapidly in some places than in others; but the structure resulting has the same properties.

The spore seems to differ from the plant more in the greater thickness of its capsule or protective covering than in any other particular. These spores are produced from the germinal matter in small oval vesicles formed at the top of the stem, which grows upwards into the air (Plate XII, fig. 1, *p*, *r*, *s*.) These organs seem to be the only part of the plant which exhibits any special peculiarity of structure.

The tissues of many living beings, a little higher in the scale of creation, consist of structures which perform different offices. One set of elementary parts may contribute mainly to increase the general tissue of the organism while another set may bring the pabulum which is destined to be converted into tissue. A third set, perhaps, seems useful merely to protect the more delicate structures within from injury, or from the influence of cold, &c. All these, it must be borne in mind, are the offspring of elementary parts, which closely resemble in their mode of growth, and in those properties we are capable of investigating, the simple structures we have been considering, but they differ entirely from them in power.

The end of the existence of the particles of the mildew (as far as the formation of tissue is concerned), seems to be fulfilled by the formation of the simple transparent tissue which constitutes the external membrane or protective covering of each portion.

In the more complicated organisms, however, the case is very different. The elementary parts differ materially in power, although they have all descended from one.

The endowments of the elementary parts composing each set are however limited, and those concerned in absorbing nutrient matter, or in forming the protective covering of the body cannot produce those which take part in locomotion or in

secretion, although all have originally sprung perhaps from only one elementary part.

Buds.—In plants and certain animals, however, consisting of several sets of elementary parts which are closely related together, it is possible to remove small portions which shall contain a few elementary parts from each set. In this case, a new organism, complete in all its parts, can be built up, the general form of the body being determined by the inherent powers of the different sets.

In the youngest buds of plants, which I have examined, I have traced the elementary parts prolonged from the different sets into the bud. Offsets from the spiral vessels can be distinctly demonstrated. It is probable that in all cases in which a bud is formed, the continuity of the several tissues of which it is composed with those of the structures from which it proceeds may be traced. The elementary parts of an ordinary leaf bud have the same powers as those which the elementary parts of the stock possess. If a set of elementary parts in the bud dies after its separation from those of the stems, the death of the bud, or a very imperfect structure, must result.

Ova.—The development of all these sets of elementary parts, from one or from a very small collection (ovum), whose powers are entirely different from those of each successive series of its offspring, and these from each other, is a very different process. At first we have an exceedingly simple structure, consisting perhaps of one spherical elementary part which, by its growth and division, gives rise very soon to a large number which closely resemble it in appearance. Gradually, however, as these multiply different sets become manifest, and from these new ones are produced. Each set, up to a certain point, very closely resembles its neighbours, but it differs from them in power. The difference gradually increases, and each set at last gives rise to elementary parts, whose properties and office are entirely different. Thus the various tissues and organs are gradually evolved. They have been formed in a definite order; the changes occurring in them after their formation, always take place in a definite order, and it is possible to demonstrate which is the oldest part of each organ just as it can be shown which is the oldest and youngest portion of each elementary part of which the organ is composed.

Throughout life new elementary parts are being formed continually, and the old ones are gradually being removed. To investigate the actual alterations which occur, the conditions which accelerate or retard the development of new parts, and to study the modifications which occur in them in disease are

questions of the highest importance to all, and should be special objects of thought and study to those who are called upon to investigate and treat cases of disease.

THE GROWTH OF ELEMENTARY PARTS CONTRASTED WITH THE DEPOSITION OF CRYSTALS.

The original view, brought forward about thirty years ago, by Schleiden and Schwann, with regard to the formation of the cells, has been generally adopted. Although certain modifications of the theory have from time to time been proposed, the doctrine, as far as the action of the nucleus and cell is concerned, and to a great extent as regards their formation, still receives general assent. Virchow, although he denies that the cell originates in a cytoblastema, and affirms that *every cell comes from a pre-existing cell*, seems, nevertheless, to consider that what Schwann looked upon as the nucleus, is the part first formed. This nucleus seems to correspond, in many cases, to what Virchow calls the cell. Virchow holds, too, that the cell exerts a modifying action upon the materials *external* to it, and that the differences of the "cell-contents (or else the masses of matter deposited without the cell, *intercellular*), give rise to the functional (physiological) differences of tissues."

The formation of these structures, by a process resembling crystallization, seems to be assented to by many writers of the present day. Schwann expresses himself thus — "we may imagine the nucleolus to be first formed by a crystallization from out of a concentrated fluid;" and one of the most recent writers on this subject, Mr. Rainey, goes so far as to state that the formation of many of the tissues is due, as far as I can understand him, to the occurrence of physical changes alone; just as particles of calcareous matter may be deposited in an insoluble form from the fluid in which they have been dissolved.

Now it seems to me that the processes of crystallization, and the growth of living elementary parts, are essentially different. I do not think that any analogy whatever exists between them. The view which I am advocating, supposes that every particle of living tissue was at one time active and possessed the power of animating lifeless particles. I do not think that by the action of any structure (cell or nucleus) upon material which surrounds it, peculiar alterations are produced in its properties or its deposition in the form of tissue, caused. I believe that, so far from the cell or its nucleus exerting any formative or modifying action upon matter outside it, the only manner in which this

matter can be changed into tissue, or converted into matter
with different endowments, is by passing into the interior of
the cell or nucleus, and then going through a definite series of
changes, the last of which consists in its conversion into tissue
(formed material). Neither, as has been already stated, do I
think that the so-called intercellular substance or cell wall
possesses any formative or modifying power of its own. I
believe this to be passive, capable of being *acted upon* or
changed, but not possessing any power of acting or changing of
itself.

Let the formation and growth of cells or elementary parts,
as above described, be compared with the process of crystalliza-
tion. Just as a crystal is increased in size, by the gradual
deposition of particles of similar composition to itself, although
different crystalizable substances may be dissolved in the fluid,
so it has been argued the cell selects from the mixed fluid which
surrounds it certain particles only which are adapted to its nutri-
tion. Yet how very different these two processes seem, when they
are considered from the present point of view. The crystal is
of the same chemical composition in every part; its form may
be destroyed without its properties being altered; and it may
be obtained again and again from its solution in precisely the
same form. It increases in size by the deposition of similar
material on the outside. In its formation no chemical change
takes place. The matter still dissolved in certain proportion in
the fluid is of the same composition as that already deposited in
the form of crystals. The material of which the crystal is com-
posed merely passes from one physical state to another. The
portion of crystalline matter, which was first deposited, is in
the interior of the crystal, while that which was last precipitated
is on the surface.

In living matter, on the other hand, the most complicated
chemical changes are perpetually taking place. Combinations and
decompositions are silently occurring which the most powerful
forces under our command, are, in many instances, incapable of
effecting. The matter of a living structure cannot be dis-
solved or liquefied and then obtained a second time in the same
form. The form is, nevertheless, definite, but it is determined
by the powers of the living mass which gave it origin. The
living elementary part is not of the same chemical composition
throughout. The oldest part of the structure is outside. The
matter, which has only just been rendered living, is in the
interior. A continual movement of the particles is taking place
in a definite direction from centre to circumference, and every
particle having reached a certain size, divides. It is possible

that the tendency of the particles to divide is a phenomenon depending upon the same force which determines their constant movement outwards from a centre.

The living matter, which is the seat of all these changes, can, for a certain period of time, communicate to inanimate matter its peculiar properties, but when it has passed through certain stages of its existence it ceases to possess this power. There is nothing analogous to this in the inorganic world.

Lifeless particles of matter, free to move, attract each other, while living particles, on the other hand, tend to animate the matter by which they are surrounded, and to spread infinitely *from* the centre, where they became living.

It is difficult to understand how any one who has carefully watched the changes occurring during growth of any living structure, can have arrived at the conclusion that the material of which it is composed, with all its wonderful and inexplicable endowments, was simply precipitated from a solution of living matter possessing similar endowments, in obedience to the same laws which determine the deposition of crystals from the fluid in which they were dissolved.

OF THE SPHERICAL PARTICLES OF GERMINAL MATTER.

Composition.—In the present state of knowledge it is very difficult to form an idea of the nature of the complex chemical changes which undoubtedly occur at the moment *inanimate* matter becomes *living*, and when a *living particle* passes into the state of formed material or dies. With regard to the chemical changes occurring *during the life* of the particles, nothing whatever is known. The most powerful affinities are overcome, and analyses and syntheses silently and perfectly effected, which cannot be artificially induced. We can, of course, only examine chemically the compounds which *result from the death of living particles*, or those which are produced by the action of oxygen on these. These substances cannot be formed independently of living organisms.

In living matter, ordinary physical and chemical forces seem to be more or less in abeyance ; but the moment life ceases, they again exert their sway, and elements which had existed in different states of combination, or uncombined, rush together, and compounds result the examination of which affords us but very slight information as to how these component elements were related to each other when they formed living matter.

Motion.—I have been led to conclude that constant movements occur in the particles of each spherule which forms part

of every mass of active germinal matter. This motion always takes place in one direction, from centre to circumference. Its rapidity varies much in different cases. I think this movement depends, not upon the existence of a repulsion between the living particles, but upon an active power which each possesses, by virtue of which it tends to move outwards from the centre, where it first became living, and which causes the particles to undergo perpetual division, and the mass of which they are composed to divide. Such tendency to move from a centre, it would seem, must be due to a force very different to that which controls the movements of inanimate matter. Moreover, while the latter exerts its influence as well on masses of the largest magnitude and of infinite minuteness, through *infinite distance*, the vital forces only exert their ascendancy when the distance is infinitely small; and it would seem that this influence can only affect matter extending but a very short distance from each separate living centre, and freely supplied with air.

Structure and Arrangement.—I have adduced facts which seem to me to justify the following conclusions with reference to the structure of the smallest living particle; but it is very probable that, as investigation advances, these inferences may be modified in important particulars. Its form is spherical, and it consists of smaller spherules varying in size; each spherule being composed of smaller spherules, and these of still smaller ones. At the surface of every one is a small quantity of matter possessing different properties to that in the interior. (Plate XII, fig. 1 *b*, fig. 3 *b*).

Each spherical particle is free to move in fluid, and the intervals between the particles are occupied by a fluid. This fluid contains, in solution, 1, matter about to become living; 2, substances which exert a chemical action, but do not necessarily form a constituent part of the living mass, and particles which are rejected, and not capable of being animated; and 3, substances resulting from the changes ensuing in particles which have arrived at the end of their period of existence, and the compounds formed by the action of oxygen upon these.

There can be no doubt that the smallest particle of living matter is of complex composition. It is impossible to conceive the existence of a living particle of any simple substance like iron, oxygen, nitrogen, etc., for *living* involves chemical change which takes place between several different elements. It seems to me, therefore, that the term *living atom* cannot with propriety be employed, seeing that *living matter* is of complex composition, while the idea of an *atom* seems to involve sim-

plicity of constitution and indivisibility. The whole question of the arrangement and form of the atoms in living matter can at present only be discussed theoretically; and I would now merely remark with reference to this subject, that although all living particles are of complex composition, many different elements may exist in very different proportions in living matter; and that there is reason to believe that the smallest particles of *every kind* of living matter are spherical. It is not possible to see with the highest powers now made, particles which would be in all probability demonstrable by more perfect glasses. The further consideration of this question is of the deepest interest; but from this point the inquiry seems to me to assume too purely a speculative character for me to pursue, as I am anxious to restrict myself to the consideration of phenomena which can be investigated by observation and experiment. I have endeavoured to prove that the wonderful changes occurring when inanimate matter becomes living, which occur alone in living beings, take place in the central part of the spherical particles of germinal matter. Discussions as to the nature of the vital forces must, I think, therefore be confined to the consideration of the changes which take place in those living spherules, of which there is reason to believe we can only see some which are comparatively of large size, and probably many series removed from their ultimate spherical components.

It is likely that as our means of investigation become more perfect we shall be able to proceed much further in the inquiry than we can at present, and shall be enabled to observe and experiment on questions which are now only open to pure speculation Is it not probable, however, that the increased knowledge thus acquired will but prove to us more distinctly that the ultimate phenomena are far beyond the reach of our powers of investigation?

To me it appears that this branch of research daily acquires more and more the same infinite extension which attends every advance in astronomical science; and I believe that the highest magnifying powers we have or can ever obtain, will fail to render evident to our senses the smallest living particles, much less inform us of the nature of the changes going on within them, when inanimate particles become living. By the use of the telescope, already brought to a far higher state of perfection than the microscope, the astronomer finds himself more and more incapable of realizing, even very faintly, the infinite vastness of the universe, although wonderful advances have been made, and some nebulæ, which until lately had been regarded as single stars, have been resolved into countless systems of worlds.

CONCLUSIONS.

1. The smallest independent living organisms, are, there is reason to believe, quite invisible by any magnifying power yet made.

2. Every living particle comes from a pre-existing living particle.

3. Living particles may increase in number and in size. Under certain circumstances a particle may retain its size, but its outer part may increase in thickness as its inner portion decreases.

4. Every living particle of mildew consists of two structures; *externally, of formed material ; internally, of germinal matter*.

5. The *formed material* was once *germinal matter,* and is older than the existing germinal matter.

6. The inanimate matter passes in solution through the formed material and becomes living in the central part of the particles of germinal matter.

7. The living growing germinal matter is composed of spherical particles, and these of smaller spherules.

8. If growth is rapid the amount of formed material is always very small, but if growth occurs very slowly the proportion is considerable.

9. In some cases the particles of germinal matter within the capsule of formed material undergo change, and secondary deposits are formed.

10. In this case the germinal matter is always found between the capsule of *formed material* and the *secondary deposit*.

11. There is no analogy between the growth of living bodies and the deposition of crystals from a solution.

12. The smallest living particles are of complex composition and are spherical. They are continually moving in a direction from centre to circumference and dividing. They can at this stage communicate their powers to inanimate matter. They pass through certain definite stages of existence and at last become formed material. These living spherical particles are the seat of the active vital changes.

LECTURES

STRUCTURE AND GROWTH OF THE TISSUES

OF THE

HUMAN BODY.

Delivered at the Royal College of Physicians, 1861,

By LIONEL S. BEALE, M.B., F.R.S.

LECTURE I.

Introductory.   Importance of various methods of preparing tissues.

MR. PRESIDENT AND GENTLEMEN,

THERE are few subjects connected with modern medicine of greater interest than the one which I have your permission, Sir, to discuss in this course of lectures.   The study of the structure and growth of the tissues is enticing from the great questions it comprehends, and is worthy of being prosecuted with the utmost diligence and earnestness, because many of the facts elucidated in the course of such an enquiry cannot fail sooner or later to become of great practical importance.

I shall only attempt to bring under your notice a very small part of this extended enquiry, and shall restrict myself mainly to the anatomy of the simplest tissues of the body.   I wish I was able to give you a complete history of the life of but one of these tissues, and describe the changes which occur during its development and growth, and the alterations which take place when the conditions under which it lives are modified,— alterations which, although quite inappreciable when they commence, may end in the destruction of the tissue, and the death of the organism.   Although I am fully conscious that this is quite beyond my power, some advantages will, I think, result, if we study the anatomy of tissues from this point of view.

The history of the changes which occur in man from the commencement of his existence to its natural close, is a history which can never be made perfect, and there is reason to fear that but few chapters will be written until long after the youngest enquirer now living will have been compelled to cease from his labours. We can hardly hope to see the outline of such a work as this firmly established on well ascertained facts; but how could our time be more usefully employed than in collecting and arranging materials, and urging on by every means in our power, researches, the results of which may contribute to form the outline of a story which as yet hardly commenced will, let us hope, be handed to our successors in a more complete form? Such a history will advance with every age, and though it can never be perfected by human power, will always afford instruction, and be read and meditated upon with advantage, especially by those whose duty it is to test its assertions, correct its errors, and add to its completeness by new observations.

The difficulty of these enquiries is indeed great, and it is seldom that the hoped-for practical application of the results of scientific investigation is obtained until long after the work has been completed. Still, experience has proved that the observer may feel quite confident that at some time or other all earnest work will be productive of useful results.

There are some who are constantly struggling to prove by reiterated assertion rather than by simple evidence, how little practical benefit is likely to result from all the scientific work which others love to prosecute. It is possible that men, who by this systematic disparagement apologise for their own dislike of labour, are the involuntary instigators of that which they desire to retard, for in all ages unreasonable opposition has been the unwilling, but not the least efficient, means of rapidly establishing truth on the firmest possible basis, and extending it far and wide. Any one who fairly compares the principles on which disease is now treated with those generally accepted even fifty years ago, cannot fail to observe a wide difference. Dogmas were laid down by authority, where now the merest tyro can only be influenced by reasons, and the clever theories of the cleverest thinkers were appealed to as the basis of practice, while in the present day a more solid foundation is being slowly, but let us hope, surely established, by submitting every opinion to the searching tests of observation and experiment.

Were the elements of physical science as generally taught as the elements of arithmetic we should not have to deplore the influence exerted by the table-turners, spirit rappers, and the

whole class of medical impostors. These men live by flattering the conceit, and fostering the ignorance of people who have never learned to think. They fear truthful investigation, and hate the diffusion of knowledge. Is it not painful to think that persons highly educated in some branches of learning, should listen attentively to this nonsense, and be utterly blind and deaf to all the inexhaustible wonders by which they are surrounded, which the human intellect is specially adapted to investigate, and the contemplation of which is a never failing source of happiness, which increases as life advances, and often retains its freshness long after the organs with which we have worked and experimented have grown old in our service, and must rest from their labours ?

By encouraging to the utmost of our power the study of physical science, we shall be more serviceable in protecting the public, since every man acquainted with the elements of physical science would protect himself, from imposition, than by endeavouring to increase the stringency of our laws.

It is, I confess, miserable to see in many instances with what effrontery and tact the charlatan, well acquainted with the weaknesses of mankind, imposes on the credulity of those he pretends to serve, and successfully hides his determined ignorance, his idleness, and his heartless greediness; but it is more miserable, and almost hopelessly disappointing, to hear it asserted that in our own ranks there are a few individuals so devoid of self-respect, and so utterly benumbed to all that is serious and good and true in medicine, as to submit to the farce of a consultation with such a one, and thus by one single act bring on us a disgrace which the courage and · self-devotion of hundreds of perhaps less successful, but more honorable men will hardly obliterate.

Advance in medicine has at all times been so intimately associated with, if not absolutely dependent upon, the progress of certain collateral sciences, especially anatomy and animal chemistry, that it is to be regretted that these pursuits are not more generally prosecuted by physicians than they are at present, in this country. When we consider how medicine has been advanced by such men as Harvey and Hunter, is it not surprising that scientific investigation in connection with medicine is not carried on under the superintendence of the physician to a much greater extent than it now is? I believe that this is in great measure to be attributed to serious defect in what ought to be an important department in all our hospitals. Many physicians must have felt the want of well arranged scientific work-rooms where various microscopical and

chemical investigations could be carefully carried out under their direction.

I am so sanguine as to hope that the time is not very far distant when this defect will be remedied and the principle generally recognized, that we should prosecute scientific investigation, in order that we may discover new truths which will certainly, though perhaps not at the moment, be productive of practical good, as well as afford what relief we can to present suffering.

In the minds of some persons there is undoubtedly an impression that such enquiries cannot be conducted without disadvantage to the patient, and there is a tendency in the public mind to draw a distinction between the so-called practical doctor who cures the ailment with a single dose, and the scientific man who, like a dreamer and useless speculator, thinks and theorises, but is not up to the direct means of giving relief to a patient in pain. We are, however, all aware how much we have learnt during the last few years from the investigations into the secretions in health and disease, which have been lately carried on both in this country and on the continent, and there can be no doubt that if careful researches could be prosecuted on a larger scale in our public Institutions great advance would very soon be manifest.

I think we should make every effort to establish such a department in connexion with our large hospitals, for surely, besides endeavouring to relieve the ills of our contemporaries, a very important part of our duty is to work out and enforce principles which when acted upon may increase the physical development and mental vigour, and largely contribute to the happiness of those who are to follow us.

In thus urging the importance of scientific investigation in its minute details to practical medicine, I am not ignorant of the difficulties with which the effort is surrounded, and had I not had some practical experience I should not have ventured to allude to the matter here. I have felt the disappointments, regretted the wasted hours, and sighed over the useless results of many days' hard labour; and like every one who has worked in this direction, have in my possession volumes of observations which have led to nothing, and long analyses from which no reliable inferences can be drawn. For seven years I worked and taught in a laboratory which I had arranged close to the hospital and although of late I have been engaged in work of another kind, I am now looking forward to an opportunity, which will I hope soon be afforded me, of carrying out on a larger scale chemical and microscopic

work bearing on medicine, which was commenced while a student, and in which I shall endeavour to take an active part as long as I have health and strength to work.

I have ventured to make these remarks because I cannot help feeling that, till within the last few years, an impression has been gaining ground, and is even now, I fear, too generally diffused, not only amongst practitioners but among students, that minute investigation tends to make us unpractical, and that work in the laboratory and in the museum is antagonistic to the study of disease in the wards of an Hospital. It seems to me that we ought, all of us, to make an effort to oppose very strongly such statements, which are most positively contradicted by the history of those who have led the most useful professional lives. This disparagement, I am quite sure, has discouraged many from prosecuting serious and useful work who would otherwise now be advancing the best interests of their profession, and employing their spare time in a manner most advantageous to themselves, instead of feeling dissatisfied with their progress, and perhaps discontented with their profession. Surely the earlier years of professional life cannot be more usefully or more happily spent than in prosecuting some branch of scientific inquiry in connection with our profession, and certainly there can be no more fitting preparation for the great work of our lives than the practice and continual study of medicine.

During the last few years, the love for such work seems to have revived, and if the taste is as widely diffused and encouraged as this College desires, the position which we shall occupy in Europe and America as prosecutors of scientific medical inquiry will not be inferior to that which is generally accorded to us in questions relating to the practical treatment of disease.

It is far from my intention to obtrude upon your notice in very positive terms the conclusions to which I have been led by my investigations, or to lay down dogmatically my own interpretations of observations, and ask you to accept them; nor shall I uphold my conclusions by bringing forward all the facts and arguments I can in their support, for I am most anxious that you should examine the preparations from which my inferences have been drawn, and consider if the arrangement you observe can be explained on any other view. The doctrine which I shall advocate has resulted solely from observation, and I did not enunciate it until about a year since, when the accumulation of facts became so considerable that I thought myself justified in attempting to frame a theory which should serve to account for the appearances I had observed, which I could not explain

by the view generally entertained.   Some of my conclusions are
at variance with the opinions generally held, especially in
Germany, and in bringing them forward I am, I think, fully
sensible of the difficulties which all observers have experienced,
and I trust that the plain manner in which I shall discuss some
of these questions will not be construed into disrespect for the
opinions of those who entertain opposite views.

I would not have placed myself in this position had I not
fortunately succeeded in making preparations, and also in
preserving them, so that they may be examined by any one
desirous of doing so, and with the highest magnifying powers
which have yet been made.

The difficulty of understanding many of the views now held,
and the still greater difficulty of teaching them, are, I think,
alone sufficient to justify the reconsideration of the whole
question of the minute structure and growth of the tissues.

There is no branch of scientific enquiry in which general
conclusions have been so many times altered as in that which
relates to the anatomy and mode of growth of the different
tissues and organs of the body, and in proposing a view which,
as far as I can judge, accounts for a greater number of observed
facts than those generally entertained, I am fully conscious
that, as investigation advances, it may be necessary to modify it
in many important particulars.   I believe that it will be found
to possess a temporary usefulness, and to whatever charges I
may be exposed in bringing forward another view, I think I am
free from the charge of increasing the difficulty of explaining
some of these complex phenomena, and proposing new and
difficult terms, the meaning of which cannot be easily defined.
I hope that the points which I shall endeavour to establish may
assist us in the attempt to determine what phenomena taking
place in living beings are dependent alone upon physical and
chemical actions, and may enable us to distinguish these from
the changes which are dependent upon powers which every
living being has inherited from those from which it sprung,
and may transmit to its successors; and which are peculiar to
every different kind of creature.

The only terms which are not generally used in quite the
same sense in which I shall employ them are the following :—

Elementary parts, into which every structure may be
divided.   A particle of epithelium is an elementary part.   The
elementary part consists of matter in two states.

Germinal Matter.—Matter in a state of activity, or capable
of assuming this condition, possessing inherent powers of
selecting certain inanimate substances, and of communicating

its properties to these, exists in all living beings, and from it every tissue is produced. I propose to call this *germinal matter*. A certain portion of the germinal matter of many elementary parts is comparatively quiescent, but is capable of assuming an active state at a subsequent period These portions are the so-called nuclei and nucleoli and new nuclei and nucleoli will make their appearance within them when they have grown into ordinary elementary parts.

The matter on the external part of every elementary part exists in a passive state, as—

Formed material, which was once in the condition of germinal matter, but it has now ceased to be active. It cannot communicate its powers to lifeless matter. Its composition, form, and properties depend upon the powers of the germinal matter which it often protects.

Secondary deposits—These are insoluble matters which vary in form and composition in different cases, and may be considered, in some cases to consist of *formed material,* which has been deposited amongst the germinal matter, instead of only external to it. Deposits may accumulate to such an extent as to cause the germinal matter to form a very thin layer between them and the formed material.

These points will, I think, be at once understood by reference to the following diagrams.

Fig. 9.

a. The smallest visible particles of germinal matter. *b.* Small collections of germinal matter, with a little *formed material* between them (as in mucus). In one, portions are seen to project, and if these were detached each one would grow and give rise to new masses. *c.* Germinal matter with a very thin layer of formed material on its external surface (cell wall). *d.* Same as the last, but with a new centre of growth now comparatively quiescent, but capable of assuming active growth (nucleus) appearing in the germinal matter. If *c* were exposed to unfavourable external conditions the whole would be destroyed, but under similar circumstances the *nucleus* of *d* might alone resist these influences, and the conditions becoming favourable would grow and produce new elementary parts,

although all but this small portion of the germinal matter had been destroyed. *e.* A thick layer of *formed material,* the whole of which was at one time in the state of germinal matter. *f.* Secondary deposits commencing to appear amongst the germinal matter, as fatty matter is precipitated amongst the germinal matter of the fat vesicle. *g.* A further stage of the same process. *h.* Separate masses of secondary deposits as in the starch-holding vegetable cells. *i.* Deposition of formed material or secondary deposit in successive layers on the inner surface of the original capsule, but leaving spaces or intervals in which currents are continually setting in opposite directions during the life of the germinal matter. *k.* Germinal matter and *formed material* which is granular, the particles of which are becoming resolved into several substances as takes place in the elementary part of the liver (liver cells). *l.* Formation of fibres from germinal matter. *m.* Germinal matter belonging to, and taking part in the formation of, the walls of a tube.

The task I have proposed to myself is a difficult one. To demonstrate to another the minute points upon which the different views are based, is not always easy when the microscope is fixed and the illumination is as perfect as can be obtained; but I shall attempt to demonstrate some exceedingly delicate structures under some of the highest powers that have been employed in the examination of the tissues of man, and the higher animals, and to pass the microscopes round the room so that every one may have an opportunity of seeing some of the specimens from an examination of which my conclusions have been drawn.

Should my arrangements at first not work quite so satisfactorily as I hope, I trust you will forgive me for having made the attempt.

I must now ask your attention to the arrangement of the microscope, by which I hope the object we have in view may be effected. The instrument is made after the manner of a telescope with draw tubes; the object is fixed across a stage below the object glass by a spring which presses against the back of the slide. By this arrangement I can easily place any part of the specimen under the object glass, and by means of a little screw-clamp I can fix it firmly in the exact spot I wish. The object is brought into focus by screwing down the middle draw tube to the proper position, and the more exact focussing is effected by drawing the tube to which the eye-piece is attached backward and forwards.

It will be observed that in this arrangement the preparation is held firmly in its place, and it is scarcely possible to alter its position if ordinary care be used. You would hardly expect that an apparatus so simple as this would enable us to examine objects with very high powers, but I shall presently show you objects under the tenth and twelfth of an inch object glasses, which I trust will at least enable you to form some idea of the structures I shall refer to. Most of the questions to which I

shall advert are very difficult to decide, and an opinion can only be formed after long and careful observation of many specimens of the same structure, so that I cannot hope to be able to convince you of the truth of my inferences, although I trust I shall succeed in proving to you that they are not unreasonable nor improbable.

The little microscope is firmly fixed in this stand which is provided with a small oil lamp giving a good light.*

Fig. 10.
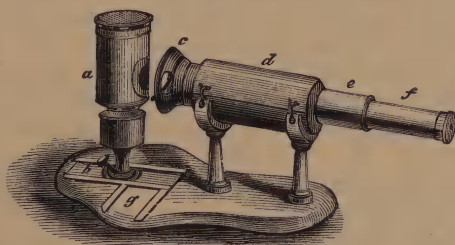
a. The lamp. b. The slide in which the foot of the lamp moves—It is fixed in its position by a small screw. c. The stage of the microscope. d. The stand in which the instrument is firmly held. e. First draw tube. f. Focussing draw-tube. g. Slide in which the lamp is placed when objects are to be examined by reflected light. The instrument and stand were made for me by Mr. Matthews, of Portugal Street, Lincoln's Inn.

The focus may be altered by drawing the tube to which the eye-piece is attached in and out, until the object is seen perfectly clearly. Each microscope is numbered, and the number corresponds with the number in the "*Explanation of the objects*," which has been distributed.

In the preparations which I shall show you the part of the tissue which is active, and which possesses the most wonderful powers of increase is tinged of a dark-red colour by carmine, which has been much used in Germany for filling tubular structures by capillary attraction. This I have termed *germinal matter*, and it exists in all living beings, and at every stage of their growth, but its proportion varies according to the age of the tissue. The youngest tissues consist almost entirely of germinal matter, while in the oldest textures little exists. Those tissues which grow rapidly and change much, contain a large proportion of germinal matter, while, connected with those which grow very slowly comparatively little is found. The tissues of the body which possess such different properties

* This instrument will be fully described in No. VIII of the Archives of Medicine.

were all once in the condition of germinal matter, and the characters or properties which the tissue possesses in its fully developed state, depend upon the powers of the germinal matter from which it was formed. Tissues which are remarkable in their adult state for the large quantity of so-called inter-cellular substance, exhibit but little during the early period of their development, while in their earliest condition they may be said to consist of cells alone. At first there is no *inter-cellular* substance at all.

The *tissue* or *formed material* is not coloured by carmine and if by prolonged maceration it be stained by it, the stain may be removed by soaking in glycerine, but the tint still remains in the germinal matter. This is a most important and very remarkable fact, and is observed in the tissues of every living being I have examined. Many difficulties have occurred in attempting to colour some textures, but these have been in a great measure surmounted, and I believe that in every living being by the action of an ammoniacal solution of carmine, and subsequent soaking in glycerine, we can positively distinguish the *germinal matter* from the *formed material,*—the active *living matter* which after passing through certain definite stages of existence, will become formed material,—from the *formed material* already existing. The same general statements already made, apply with remarkable accuracy to morbid growths. Those which grow rapidly consist of much germinal matter in relation to the proportion of formed material, while those of very slow growth contain matter capable of being coloured by carmine in small amount. I shall have to refer more particularly to the relation of the formed material to the germinal matter in my next lecture, and I shall allude to some very remarkable effects produced by the carmine.

In most of my preparations the capillaries have been filled with a transparent Prussian blue injection containing a little alcohol and chromic acid ; so that at the same time that the vessels are filled with colouring matter, the adjacent textures become permeated with a fluid which entirely prevents any tendency to decomposition, and many transparent albuminous textures are rendered just sufficiently granular to enable us to see their arrangement distinctly.

By these methods of preparation several minute points have been determined, such as the relation of the cells of the liver to the terminal branches of the duct, the ultimate distribution of nerve fibres in several different tissues, the structure of the ganglia of the sympathetic, the relation of the terminal branches of the nerves to the dentinal tissues. Nerves have

been readily traced and microscopical ganglia demonstrated in the fibrous tissue of the pericardium, in the submucous tissue of the epiglottis and pharynx, in the transverse fissure of the liver, and in the substance of the tongue, the formation of bone and dentine has been studied under the highest magnifying powers; and by following out the same plan I have reason to hope that some of the most difficult anatomical questions may be decided. Not the least advantage of the process is, that the tissues may be preserved permanently and subjected to examination with the highest powers.

You will find from the remarks I shall make, that I have been led to differ in opinion upon some very important questions, from many of the highest authorities. We shall have to consider, for instance, whether certain appearances depend upon the presence of solid bodies in the tissues, or are spaces containing fluid, whether certain delicate lines are fibres or tubes, which is the oldest and which is the youngest part of a tissue, and of each component part, and a great number of questions which one would think could be very easily decided, but which really prove most difficult to determine.

As to the offices performed by tissues, you will also find my conclusions altogether at variance with those generally arrived at, and to such an extent, that in tissues generally, a structure which I believe to be inactive, (the so-called intercellular substance), has been considered to be the seat of positive formative power, and on the other hand, that which I believe to be the actual seat of the vital changes, has been deemed the least important part of the tissue, and perhaps even merely accidental (the nucleus in certain instances, the so-called cell in others). Such questions can only be determined by an appeal to the preparations, and I hope to be able to convince you that many of my conclusions are justified by the appearances presented by the specimens which have been prepared by the process I have adverted to.

Let me now show you some preparations which illustrate the general points which are brought out in various textures by the method of preparation which I have devised, and I shall ask you to compare these specimens with parts of the very same tissues prepared in a different manner. I am sorry thus to trouble you with what may seem very uninteresting practical detail, but I think you will find that many of the discrepancies in the statements of different observers, arise simply from the different manner in which they have subjected the specimens to examination. In fact I think it will be found

that many of the most difficult questions can only be solved by studying very carefully the circumstances under which the tissues in question may be examined so as to display their characteristic peculiarities in the clearest manner possible. I have been careful to select specimens for illustrating these points, which are likely to prove interesting to you on general grounds, so that we shall lose no time unnecessarily.

No. 1. An injection of some simple papillæ of the human tongue under a magnifying power of 130. Three separate ones are seen. The epithelium has been removed and the capillaries are seen fully injected with Prussian blue. Oval bodies, consisting of germinal matter, tinged bright-red with carmine, pass in various directions in the papillæ, and are very numerous at the summit of each. Of these oval bodies, some are connected with the capillary vessels, but the great majority, I shall endeavour to prove, are connected with the nerves which form a sort of network lying on the surface of the capillary vessels, and embedded in a transparent tissue.

No. 2. Is a thin section removed from the central part of the tongue of a white mouse, prepared as the last specimen, under a power of 215. The muscular fibres are observed with capillaries ramifying over them. The oval nuclei are principally connected with the capillaries and nerves, but these points require a much higher power for demonstration. These specimens illustrate the general appearance of the capillaries when injected with Prussian blue, and the oval bodies when stained with carmine, according to the plan I have described.

No. 3. Is a thin section from the tongue of a mouse just killed. It is placed in a little very weak glycerine, and magnified 130 diameters. It contrasts remarkably with the last specimen. The smaller vessels cannot be discerned. Nuclei are seen, but very indistinctly, and in smaller number than they exist. The want of definiteness about the structure, would cause you to conclude that in this specimen, areolar or connective tissue predominates over every other tissue, and you would be led to conclude that the nuclei are connected with the fibres of the areolar tissue, although you could not see an absolute connection between the fibres and nuclei.

No. 4. Is another specimen from the central part of the tongue of the mouse, from the same part as the last section, but injected and soaked in carmine. The ' connective tissue' of the last specimen is seen to contain numerous capillaries and nerve fibres. The nuclei seen in the section are clearly con-

nected with the nerves and capillaries. Nerve fibres, not more than the one ten-thousandth of an inch in diameter, can be traced to and from the ganglion. The nuclei on the surface of the ganglion usually considered as the nuclei of the connective tissue surrounding its cells, belong to the nerve fibres which grow from the cells. This specimen is magnified 250 diameters, and in another lecture I shall show parts of this preparation under powers of 700 and 1,700 diameters, and hope to demonstrate the real nature of the connective tissue and its relation with other structures.

There is, however, no organ which enables me to illustrate the importance of different processes of preparation so well as the liver, and as the structure of this gland is of the utmost interest to all of us, in connexion with the derangements taking place in disease, I could perhaps hardly select an illustration which would be more useful.

The anatomy of this gland has long been one of the most vexed questions in anatomy, and of late the opinion has been gaining ground that the ducts terminate amongst the cells, which do not lie within tubes or follicles, as in all other true glandular organs in the higher animals. Hence this organ has been placed in the class of glands without ducts, and removed from the category of true glands.

Upwards of six years ago I succeeded in injecting the ducts of the liver, and believed that I had demonstrated that the ducts were immediately continuous with tubes containing the liver cells, —a view which had been held by several observers, although no one had succeeded in proving the point by specimens. I regarded the liver as the most perfect type of gland, because the largest quantity of secreting structure and blood were brought into the closest relation, while they occupied the smallest possible space. It appeared to me that the relation between the blood and the secreting cells, was the most perfect which could possibly be devised to fulfil the ends in view. My preparations proved to me that injection passed directly from the ducts into a network of tubes with very thin walls, which were occupied with the liver cells. The coloured injection passed between the cells, and the walls of the tube, insinuating itself through very narrow channels, but nevertheless forcing its way along these tubes for a considerable distance, and sometimes it reached the centre of the lobule. As I could force injection thus artificially in a direction the reverse of that in which the bile flows during life I considered that the possibility of the bile flowing between the walls of the tube and the cells fully proved, and that it was quite unnecessary to assume that it was passed on from cell to

cell, a process which is not carried on I believe in any organ whatever.

These conclusions were published in a paper in the Phil. Trans., in 1856. The investigation is so difficult that I ventured to express the opinions I had arrived at in terms which some writers have slightly misunderstood, and they have given me credit for feeling more doubt on the subject than I actually had. However, after an interval of nearly seven years I can now speak with far greater confidence.

There are probably few anatomical points more difficult to demonstrate to others positively than this, and it is therefore only right that one should allow full weight to the investigations of those observers who have been led by them to form a different opinion, and I am most desirous of doing so, but I was not prepared for finding a drawing copied by myself as nearly as possible line for line from one of my preparations, distorted in such a manner that it never could be recognized as indicating in the least degree the appearances which actually exist. Prof. Budge of Greifswald, gives me credit for so gross a misrepresentation of an actual appearance that I fear he must at least think me very blind or very prejudiced, or perhaps both. I did not believe that any one who was himself accustomed to microscopical work would have considered that the merest tyro could have made such a mistake, as the one which I am credited with by this Professor. However, here is my drawing of the specimen, and here is Prof. Budge's inference from my drawing of the appearance of the specimen which he has never seen, and I now pass round the preparation itself, which was made seven years ago (5). It is magnified 215. You will see the blue injection amongst the cells in the tubes, and not the faintest indication of the tubes around each cell, which Prof. Budge states he has seen, and feels convinced exist in this specimen. I hope to have the pleasure of affording to Prof. Budge some day a similar opportunity of comparing the specimen with the drawing.*

No. 6 is a corresponding preparation from the human liver magnified 130, showing the ducts just at the edge of a lobule, and their continuity with the tubes of the cell-containing network.

No. 7 is also from the human liver, and shows the capillaries injected blue, and the cell-containing-network alternating

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* I have made many injections with the chromate of lead and every other opaque injection I could lay my hands on, and have stated that I always failed. Professor Budge does not seem to have tried the plan which I employed for preparing my own specimens.

with them, and having in all parts of the lobule exceedingly thin walls, but quite distinct from the capillaries. This preparation is magnified 215.

Perhaps, however, the most perfect demonstration of the cell-containing-network, and its continuity with the ducts is obtained from the examination of the liver in cirrhosis, in which disease the cells and tubes shrink, the change commencing at the portal aspect or circumference of the lobule, and proceeding gradually towards the centre.

No. 8 is a section of a healthy liver under an inch object glass. The portal vein was injected with carmine, and the hepatic vein with Prussian blue. The capillaries of the lobule are filled with the colouring matter—those in the centre of each lobule being blue, while those at the circumference are red. Observe how very narrow the interlobular fissures are, and how in many places the capillaries of one lobule are continuous with those of adjacent lobules. The interlobular spaces are clearly destitute of any areolar or fibrous tissue. They are occupied by the branches of the portal vein which you see, and branches of the artery and duct, and lymphatics, which have not been injected in this specimen.. Let this specimen be compared with the cirrhose liver (No. 9), in which the vessels have been also injected. What a wide space exists between the contiguous lobules, of which but very little, and only of the central part of the lobule, remains in many cases. Vessels and tubes, which will be seen more distinctly in another specimen, are observed in the substance of the tissue usually stated to be fibrous.

No. 10 is a specimen of a cirrhose liver, magnified 130, soaked in carmine, and now you can see the shrivelled cells within the narrowed tubes, and the network so distinctly, that you will hardly fail to wonder how it has happened that the nature of this so-called fibrous tissue had not been made out long since—but many of the most delicate and beautiful textures appear fibrous enough when placed in water and roughly examined, and thus morbid changes have been supposed to originate in a really passive structure, the areolar or connective tissue.

No. 11 is a specimen from the same liver put up in water, and not a vestige of anything but 'fibrous tissue' is to be seen where we now know numerous tubes and cells and vessels are actually to be demonstrated. By immersing a delicate preparation in water, I can often produce the appearance of the presence of a large quantity of fibrous or connective tissue.

These specimens will, I think, serve to satisfy you of the

great importance of preparing tissues, for I have clearly proved
that many structures ordinarily invisible may be demonstrated
most distinctly by certain special processes.   I might have
taken illustrations from almost any other tissues of the higher
animals, or from the lower animals or plants, but I have chosen
those which seemed to bear most directly upon that department
of microscopical enquiry, which is of the greatest interest to us
as practitioners of medicine.

LECTURE II.

Of the Structure of the simplest Living Beings.

MR. PRESIDENT AND GENTLEMEN,

LET me suppose a physician, with plenty of time at his disposal, who had a love for work, and was anxious to study the nature of any disease. Such a man would continually feel desirous of ascertaining the actual changes which are going on in the organisms of his patients while they were under observation. He would very soon find that it was absolutely necessary to work at physiology and pathology or he would not feel in a position to prosecute any special enquiry. Now he would find the greatest difficulty in coming to anything like a conclusion with regard to questions which clearly must be positively settled before he could proceed. He would thus be driven to work at the minute anatomy and chemistry of textures in disease, and soon he would discover that many fundamental questions of mere anatomical demonstration had not been determined, and the most conflicting views as to the order of growth of textures and their action, would prevent him from feeling any confidence in his work. Next he appeals to the healthy structures, and now he is dismayed at finding that we are not sure how nerves terminate in various tissues, and, while in chemistry he finds the indefinite term 'extractive matters' applied to a considerable quantity of matter, of the nature of which he can learn very little, so in anatomy he hears of areolar or fibrous tissue, or indeterminate tissue, existing everywhere, and especially abundant in the very situations in which

he would expect to find nothing unnecessary, and the arrangement of the tissues of the most beautiful character, according with the wonderful delicacy of the offices to which he knows them to be subservient. He looks for some general explanation of the appearances he sees, and he finds cells described in works, and delineated with most distinct cell-walls, contents, and nuclei, but when he comes to examine the tissues, it is but seldom he detects anything answering to the ordinary description of a cell, and in so simple a structure as cartilage, he can scarcely find any two observers who agree as to the meaning of the appearances observed.

He enquires how a tissue grows; which is the oldest part, and which the youngest?—how food becomes tissue?—where inanimate matter becomes living?—what is actually living, and growing, and changing, and what has ceased to live and change, and has grown to its full dimensions? Every one who has thought earnestly on medicine during the last few years, must have frequently asked himself these questions.

Let us suppose such questions now asked, and before we proceed further in the enquiry, and in order that we may get them answered in the simplest and clearest manner, let us appeal in the first instance to one of the simplest living structures we are acquainted with,—common mildew. I have described at some length the changes taking place in this structure, and propose now to refer very briefly to the results.* We shall afterwards be able to discuss with better chance of success the general anatomy of the tissues of the higher animals, and we shall be able to examine the cell theory and other doctrines proposed to account for the formation of the structures of which living beings are composed.

Let us try to make out the history of the life of this simple living structure, and consider how its growth and other characters are influenced by conditions somewhat different to those under which it grows most favorably. The consideration of the changes occurring during its development and nutrition is extremely interesting.

When we attempt to examine the structure of the simplest forms of living beings, we cannot but regard the extreme minuteness of many independent organisms which live, and grow, and increase their kind, with the utmost astonishment. We shall scarcely be able to realise this minuteness at all. When I watch the appearance of minute organisms in water containing a little dead animal or vegetable matter, I feel sure

* Archives of Medicine, No. VII, page 179.

that many of the living particles were in existence some time before they had grown large enough for me to see them with the highest power I have been able to obtain (1,700 diameters made by Messrs. Powell and Lealand).

So also in all other living beings, the living particles by which the active changes are effected, are there is reason to believe far too small to be seen.

Of the *structure* of such organisms and particles we have as yet learnt nothing by direct observation, but from carefully investigating the structure of larger bodies closely allied to these, as ordinary mildew for instance, some conclusions as to the manner in which growth takes place may be arrived at. I have been led to certain inferences with regard to the structure of these simple forms of life, to which I shall now very briefly allude.

As I shall have very frequently to refer to these points in the course of the ensuing lectures, I must ask your careful attention to them. I shall endeavour to prove that growth in all living structures occurs in the same manner,—that the matter to be animated passes in the same direction in all,—and that the living particles invariably pass through certain stages of existence, and end by giving rise to material totally different in composition to the living particles. This may be further altered, but it cannot reassume its former characters, properties, or powers. The difference in the results of the life of different living organisms depend upon their powers and these they have derived from their predecessors.

Living particles cannot be distinguished from each other by microscopical observation, and in consequence it is utterly impossible, from the structure of a living particle, to predicate its office, or, so to say, the results of its living, nor to tell whether it has belonged to one of the lowest or highest organisms, to an animal, or to a plant.

When I use the word *living*, I employ it in a general sense, and mean that active changes, some of which can be explained by physics or chemistry, while others cannot, are taking place, or are capable of taking place, under favourable conditions; and by *dead*, I understand matter which has already undergone these changes, and which is brought again under the uncontrolled influence of physical and chemical forces. The shaft of a hair, and the particles of the epithelium on the surface of the cuticle, are just as dead *before* they are *detached* from the body as afterwards, but there are constituent elementary parts of every age leading uninterruptedly from these dead particles which have no power of increase to those which have only just

commenced their existence, which are nearest the vascular surface, and are undergoing rapid multiplication. Now it is as impossible to indicate the precise moment at which a living particle ceases to be able to produce particles like itself, as it is to announce positively the day or hour of our lives when we cease to ascend towards the highest point of vital activity we are to attain, and begin to decline. I shall, however, I hope, be able to describe some of the important changes which take place in the elementary parts as they grow, and I shall contrast with each other elementary parts of different ages, from the same tissue. Every elementary part consists, as I have already stated, of germinal matter and formed material which was once in the state of germinal matter. Just as in the cuticle on the surface of mucous membranes, and in certain glands, elementary parts exists of every age, so every tissue and organ in the body is composed of elementary parts in every stage of existence, and arrangements exist by which the oldest *formed material* may be removed. Some formed material is resolved into simpler compounds, and removed very soon after its formation; while in certain tissues the formed material is of a very permanent character, and it is doubtful, if in certain cases the formed material which now exists in our bodies will not remain in much the same state as long as we live.

Most important changes may be brought about by the fluid in contact with this formed material. In health it is bathed with a fluid which preserves its integrity; but in certain cases the composition of this fluid is so altered that the formed material undergoes changes closely resembling those which may be induced in it artificially, if kept at the temperature of the body, in a fluid which will not protect it from the influence of oxygen. Under these circumstances it may undergo most important changes; but these points will be more fully discussed, when the general anatomy and order of growth of the healthy tissues of the body have been considered, and I only now allude to them for the purpose of showing at once that we must not look upon disease as a condition essentially different and separated by a distinct line of demarcation, from the healthy state, but rather look for a disturbance in the rapidity of the processes of multiplication and decay of the elementary parts, and alteration in the composition of the fluid which brings to them nourishment, or which prevents the uncontrolled action of destructive agents on the formed material.

If the spore or any segment of the stem of a simple fungus be examined, it will be found to consist of an external capsule, enclosing some very transparent matter. The outer

capsule is comparatively firm, and hard and unyielding; but the internal substance is soft, perhaps almost diffluent, and is easily destroyed. It may be washed away and removed, while the external capsule will retain the same characters which it possessed before it was disturbed. You will say at once the external membrane is the *cell-wall*, and the material within, the *cell contents*, while the distinct particles amongst the contents are *nuclei*. Let us, however, for the present avoid all terms which involve theories, and consider how these parts are formed in these simple structures. The new matter is certainly not added on the external surface, for if this were the case the outer membrane would increase in thickness, while the mass within would remain of the same size as when it was first seen. In some instances the outer membrane increases in thickness, and the matter within also increases, but sometimes the outer membrane remains very thin, while the matter within is seen to undergo a considerable increase. After the whole mass has reached a certain size, it divides and the process is repeated in each of the resulting structures. Very soon perhaps millions of minute organisms are produced. When this division does not take place very rapidly, the external membrane of each particle is observed to increase in thickness, and generally, it may be said that the slower multiplication occurs the thicker this becomes.

Is the new matter added just within the outer membrane? If this were so, at one time matter like that of which the membrane is composed would be formed, and at another, the inner soft material must be produced. It would follow, too, that in some cases the material must be entirely converted into the one substance, and in others it must give rise alone to the development of the other. The increased thickening of the external membrane is often produced at the expense of the inner matter.

Is the external hard material formed within the substance of the envelope? This question has been already proposed in a previous one. From a consideration of numerous observations, I feel convinced that the new matter,—the pabulum,—the nutrient material,—which is about to become a part of the living mass, passes through the external membrane, and amongst the particles of which the central mass is composed. I believe it passes into the interior of these particles, and having been brought into very close contact with their component particles, becomes endowed with the powers they possess, and is then living.

The doctrine to which I have been led is shortly this,—that the smallest living particles, of all living beings, are spherical, and I believe these are composed of spherical particles *ad infinitum*. The inanimate matter passes into the spherical particles, and

there becomes endowed with their wonderful powers,—in fact becomes living. The living spherules move in a direction from the centre towards the circumference of each spherule to which they belong. Their tendency to divide is due to the same force which compels them to move constantly *from* the centre where they became living. Each particle is preceded by those which became living before it, and succeeded by others which were animated since it commenced to exist. This movement outwards occurs in the living particles of all living beings, and its rapidity determines the rate at which the structure grows.

The particles in passing outwards, gradually lose their power of animating matter, and at last having arrived at a considerable distance from the centre, where they became living, undergo most important changes, and are resolved into substances having properties very different to those which the living particles possessed during the earlier periods of their existence. The particles now cease to move, they lose their active powers, and perhaps coalesce to form a firm hard substance like the external membrane of the mildew, or they may become resolved into compounds which are completely soluble in fluid, which are perhaps very soon decomposed into substances of a much simpler composition. This outer substance, resulting from changes occurring in the oldest particles of the inner matter, I propose to call *formed material*, and the living matter within, which may increase in the most rapid manner, which gives rise to every tissue, and is in fact the growing living part of every structure, from which all new structures originate, I shall speak of as *germinal matter*. The characters of the *formed material* depend upon the powers of the particles of the germinal matter, and it is affected by the conditions under which these grew. The powers of the germinal matter depend upon those of the germinal matter which gave it origin. As the *composition* of the *formed material* depends entirely upon the properties of the germinal matter which produced it, the substances resulting from the disintegration of the formed material, and the compounds resulting from the action of oxygen on these are peculiar, and differ materially from each other, just as the properties of the *formed material* differ in the various tissues and in different living beings. It is, therefore, very doubtful if these substances will ever be produced independently of living matter. Undoubtedly if the component elements could be brought within the sphere of each other's action under the same condition as in the living organism, the same compound would result, but as these conditions cannot be brought about artificially, and cannot be conceived to exist except in living bodies, this is

not saying much. It would, I think, be as inconsistent with the advances science has now made, to conclude that these compounds can be produced artificially, as to believe that man, by arrangements of conditions within his power, will at length succeed in producing a living structure. Every living particle can alone spring from preexisting particles, and every particle of albumen, casein, fibrin, &c., is produced under conditions which can only exist in living particles.

In many cases certain of the particles of the germinal matter grow more slowly than others and remain perhaps for a long period in a comparatively quiescent state. These masses are generally spherical or oval, and they have a power of resisting the action of external circumstances which would destroy the active portion of the germinal matter. These are the so-called nuclei, and from them new structures may spring even if the germinal matter in which they lie be destroyed. When they become active, certain minute particles within them may become new nuclei, while the particles of the original nucleus increase and pass through the various stages of their active existence, and at last become resolved into formed material. Generally, when the conditions under which an elementary part is placed are very favourable for the growth of the germinal matter, the most rapid increase in size may be observed to occur in the particles just within the envelope of formed material, and not unfrequently numerous spherical masses of germinal matter may be seen in close contact with the membrane, and therefore as near as possible to the nutrient matter.

In some cases, after a layer of *formed material* has been produced externally, and the whole mass has reached a certain size, certain particles of the germinal matter become resolved into *formed material,* which collects as one mass, or in the form of several separate granules or globules, which may accumulate amongst the particles of the germinal matter. If this process continues for some time the germinal matter forms a thin layer between this mass of formed material, which I propose to call *secondary deposit,* and the outer membrane or envelope of formed material, a position in which the germinal matter (primordial utricle) of the vegetable cell and that of the fat vesicle (nucleus) are found. The composition of formed material in the centre of the mass is not the same as that surrounding it, but not unfrequently they are composed of substances closely related to each other.

From these remarks you will infer that one essential change taking place in living particles is a constant motion *from centres,*

and the constant formation of new centres from every one of which infinite growth may take place. This power of infinite extension is restricted within due limits by circumstances which we shall take the greatest interest in studying, and I shall have occasion to draw your attention to cases in which these restrictions are diminished to a considerable extent, and, in consequence, structures which we know as morbid growths or formations result.

Regarding a growing spore of mildew as an elementary part, it consists externally of *formed material*, within which is the *germinal matter*. Certain portions of the germinal matter are not in a state of great activity like the remainder, and these are nuclei from which new growth may proceed if the formed material and the remainder of the germinal matter should be destroyed. If there are no nuclei no future elementary parts can be formed, and the death of the germinal matter renders it impossible that new structures can result from the mass.

The structure of mildew is seen in No. 12 × 700, and No. 13 × 1,700 diameters.

Alkaline colouring matters have no effect on the formed *material*, but colour the *germinal matter* very strongly. In some very interesting specimens, coloured by immersion in an ammoniacal solution of carmine, obtained from certain fibrous textures, which I shall show you, there is no distinct line of demarcation between the germinal matter and the formed material. Most externally is the *formed material* quite colourless, then comes a layer of very young and imperfectly hardened formed material, which is slightly tinted ; next, germinal matter, darkly coloured, and amongst this, nuclei most intensely coloured. The structure which is most intensely coloured is farthest from, and that which is not coloured at all, in immediate contact with, the colouring matter. The carmine can be made artificially to pass through the layers of formed material unaltered by them, to the germinal matter, where it becomes precipitated, probably in consequence of the acid reaction of the germinal matter. Am I not, therefore, justified in inferring, that inanimate matter, about to become living, pursues a similar course, and that every living particle increases by growth from centre to circumference, the oldest portion of each spherical component particle being external, the youngest,—that which was but just now inanimate matter,—in the centre ?

LECTURE III.

Of the Tissues of the higher Animals and Man.—What is a Cell?—The Cell and other theories.

MR. PRESIDENT AND GENTLEMEN,

In my last lecture I endeavoured to show that mildew, and all such simple living structures, were composed of matter in two states, *germinal matter* and *formed material.* I endeavoured to prove that the *formed material,* of which the external envelope was compound, was once in the state of germinal matter, and that the inanimate matter, which formed the pabulum or nutrient substance, passed through the outer covering of formed material into the germinal matter, in the particles of which it became living. Here all those wonderful powers, which the germinal matter itself possessed, are communicated to the inanimate particles. I brought forward facts to show that the germinal matter was composed of spherical particles, and these of smaller and still smaller spherules. I believe that these spherical particles always move in a direction from centre to circumference. The formed material differs as much from the germinal matter in its structure as in its properties. The germinal matter alone grows and is active, and can alone animate inanimate matter. The properties of the formed material depend upon the powers of the germinal matter from which it was produced. These powers were derived from the germinal matter, which gave it origin, and so on from the beginning. The germinal matter possesses the power of infinite growth, by which statement 1 mean, that this material will continue to increase as long as it is placed under favourable.

conditions and supplied with the proper pabulum or nutrient substances. The germinal matter is coloured by alkaline colouring matters, especially by carmine, while the formed material remains perfectly colourless, although it is much nearer to the coloured solution than the germinal matter. I hold that we are not able to form any opinion as to the size of the smallest particle capable of independent existence and endless increase, but I feel sure that the smallest living particles we can yet discern have been growing for some time before they were large enough to be seen through our most perfect microscopes. We have now to consider how far these conclusions are applicable to the tissues of the higher animals.

However large and complex the organism may be, it is very easily separated into certain parts or organs which are set apart for the performance of distinct offices. The body of a vertebrate animal contains, as we all know, bones, muscles, fat, the liver, kidneys, the brain, and nerves, &c.

Each of these may be resolved into elementary organs. An entire bone may be regarded as consisting of an assemblage of certain small portions, each of which contains every structure essential to the constitution of bone, and necessary for its growth. A lung, or a kidney, or the liver, may, in the same manner, be shown to consist of elementary lungs, kidneys, or livers, although these cannot always be perfectly isolated.

In different animals, the size of these elementary organs differs, but not to the same extent as their number. An organ of a large animal, like the whale, differs from the corresponding organ of a small one like the mouse, enormously as to the number of elementary organs of which it is made up, but in a much less degree as to the size of each of these.

Each elementary part is composed of several structures having very different properties. An elementary lung is composed of a delicate transparent membrane, with elastic tissue, vessels, a prolongation of the bronchial tube. These structures are themselves compound. Connected with the smallest arteries we find nerve fibres, elastic tissue, muscular tissue, and epithelium. The nerve fibres, muscular fibre, and epithelium, are composed of elementary parts, and each elementary part consists of matter of two states,—*germinal matter*, active and growing, capable of multiplying itself,—*formed material*, passive and incapable of multiplying itself, which was once in the state of germinal matter. An elementary part of the liver in the same way is composed of the germinal matter within, and the formed material externally,—the outer part of the formed

material is gradually altered, and at last converted into bile and a substance easily converted into sugar.

An elementary part of bone consists of a mass of germinal matter, external to which is formed material, which gradually becomes impregnated with calcareous salts from without inwards, channels (canaliculi) being left, along which fluids pass to and from the germinal matter in the centre, which gradually becomes inclosed in a space (lacuna).

An elementary part is seldom more than the 1–1000th of an inch in diameter, and frequently it is very much less. In the adult organism it is often difficult to recognise the elementary parts in all cases, in consequence of changes having occurred in the course of their growth, but in the early life of every creature they are distinct enough in every tissue. In the higher animals these elementary parts are arranged in certain collections which possess very different endowments.

In some of the simplest living beings the entire organism may be regarded as consisting of one elementary part.

Every elementary part comes from a pre-existing elementary part; but it does not follow that its endowments are to be the same as those of the elementary part from which it sprung.

We must not look upon the elementary parts of a tissue as bodies which, having assumed a definite form and reached a certain size, remain perfectly stationary, but as structures which are continually undergoing change—not a single particle of which they are composed is still. It is true the movements occur so slowly in some as to be imperceptible, except after long intervals of time, while we can scarcely conceive the rapidity with which change takes place in others. But movements must occur in all, and they take place in the same direction. The elementary parts, which we examine in our microscopes, were undergoing change just before they were removed from the living structure. We have stopped the changes at a certain point, and, as the ages of the elementary parts differ materially, by carefully comparing the appearances in several, we may obtain, after numerous observations, data which enable us to form something like a connected history of the life of one of them.

These elementary parts are usually termed *cells*, and the cell is defined as an organ, consisting of a *wall* permeable to fluids, with certain contents within, and usually, but not constantly, a nucleus. In the process of secretion it is believed that certain materials pass through this wall into the interior of the cell by endosmose, and then become altered by powers existing in the cell or resident in the nucleus, and, having undergone conversion into new substances, pass through the

wall of the cell by exosmose, and constitute the special secretion. In tissues it is believed that the cell exerts a peculiar action on the matter which surrounds it, by reason of which this manifests certain peculiar and characteristic properties.

It is the exception rather than the rule to find that the contents of a cell are in a fluid state, and when this is so, numerous living particles are suspended in it. In the liver cell the contents are certainly tolerably firm. In the kidney cell they present the same characters. Their consistency generally is such that it is impossible to conceive the flowing in and out which is imagined. Again, if endosmose continued for a time, and then the contents remained stationary, and afterwards exosmose occurred, we ought to be able to see the alteration in the size of the cells taking place within a very short period of time; but no such change has been observed. It is difficult to conceive endosmose and exosmose occurring at the same moment at all parts of the surface of the cell wall, for the physical conditions which would lead to the one are absolutely incompatible with the other. Cyclosis in plants has been accounted for by endosmose; but it would, I think, be impossible to cause any particles to pass round and round a closed vesicle in a constant direction by currents flowing in towards the interior from every part of the surface. There are other difficulties in the generally accepted theory which would be tedious to follow out, and, as I shall endeavour to prove the absence of the membrane as a constant structure, it is unnecessary to detain you by endeavouring to show that the changes occurring in the formation of secretions could not be explained by endosmose and exosmose through such a structure, supposing it to exist.

According to the generally received theory, the cell wall is considered a most important structure; but it does not exist constantly. There is a very large class of the lower animals from whose bodies protrusions may be formed in different parts, and these protrusions may meet here and there. Where they touch, they coalesce. Clearly, then, there can be no investing membrane here; neither is a living structure of this kind confined to the lower animals. It exists in man himself. I have seen such protrusions from mucous particles both from the nose and also from the bronchial tubes, under a power of 1,700 diameters. A portion of the mass slowly extends itself outwards; perhaps three or four such outgrowths may be seen in different parts of the mass. If detached, they assume the spherical form; but if two come into contact they coalesce. These movements only lasted for a minute, or less,

after the mucus was transferred to the glass slide.   Protrusions
may be often observed to occur from the white blood corpuscles,
and in rare cases the red blood corpuscles adhere so intimately
to each other that it is difficult not to believe that the outer
part of their walls consists of a soft viscid matter which runs
together when several come into contact.*

It is clear, therefore, that the cell-wall is not a constant
structure, and that living organisms and elementary parts of
living organisms, may exist without it.   Again, in the younger,
so-called cells, of the cuticle, contents and a cell-wall are figured
and described by authors generally; but in the old cells, the
contents become altered and incorporated with the wall in a
manner which has not been explained. The liver-cell is usually
appealed to as an excellent example of a cell ; yet who has proved
the existence of a membrane ?   Seven years ago, long before I
had attempted to form any general views of structure, I tried
to prove the existence of this cell-wall; but utterly failed, and
was obliged to mention this in my work on the liver.†

No. 14 shows the appearance of elementary parts (cells) from
the liver of the mouse.   Many contain two of the so-called
nuclei, and some contain three or four.   Nuclei are observed
of all sizes, and the amount of formed material is very different
in the different masses.   In some elementary parts, the outline
is sharp and well-defined ; in others, it is rough and angular ; and
in some, the outer part seems to be undergoing disintegration.
No cell-wall is to be demonstrated around these masses.   The
outermost part of the formed material gradually becomes dis-
integrated and resolved into soluble substances.   The largest of
the so-called nuclei are, in fact, becoming elementary parts ;
and what would be called their nucleoli would then become
nuclei.   Some of the masses are very irregular in shape,
angular, and often much elongated, as if they consisted of soft
material which had been moulded in a tube.

In No. 15, elementary parts from the liver of an old man
aged 74, are seen. The liver appeared healthy. The elementary
parts are, for the most part, small ; and there is not that very
distinct line of demarcation between the germinal matter and the
formed material which was seen in the last specimen, and which
is in part due to the method of preparation.   Oil-globules and
particles of colouring matter have been precipitated amongst
the formed material.

No. 16 contains elementary parts from a cirrhose liver.

* A case is mentioned, and a drawing given, at page 264 of the " Microscope
in its Application to Clinical Medicine." (2nd Ed.)
† " On the Anatomy of the Liver of Man and Vertebrate Animals," 1856.

The quantity of formed material here is much greater than in the last specimen; depending probably on the difficulty to the free escape of the bile caused by the wasted contracted state of the tubes of the network at the outer part of the lobule.

But, you will say, there can be no doubt as to the cellular nature of the red blood corpuscle. This is admitted by all to consist of a membrane with certain fluid coloured contents. A nucleus is to be demonstrated in some, although not in the adult human blood corpuscle. The opinion generally received is certainly that the human red blood corpuscle is a cell with red contents, the nucleus of which has disappeared, or else it is the free nucleus of a cell,—and here the question is dismissed.

But the blood corpuscle may also be regarded as a corpuscle consisting of matter of different density in different parts, being firm externally, but gradually becoming softer, so as to approach to the consistence of fluid towards the centre. Dr. Dalton, of New York, has expressed this opinion of the structure of the blood corpuscle in his published lectures; and I believe some few other observers entertain similar views.

I have never succeeded in seeing the cell-wall said to exist, neither have I been able to confirm the oft-repeated assertions with regard to the passage of liquid into the interior of the corpuscle by endosmose, its bursting and the escape of its contents through the ruptured cell-wall. When placed in some liquids, many of the corpuscles swell up and disappear; but I have never seen the ruptured cell-walls. The red blood corpuscles from the same animal differ in character in a much greater degree than observers generally seem disposed to admit. Some are darker and harder than others. Some are so transparent as to be invisible without the greatest care, and corpuscles may be found which are not more than the fifth or sixth of the size of an ordinary blood corpuscle. I have failed in my attempts to colour the red blood corpuscles drawn from capillaries or from a vein with carmine, but I have succeeded in colouring many in clots taken from the vessels after death; and, in some instances, certain of the corpuscles within the capillaries of a stained tissue have been coloured. These corpuscles were very much smaller than the white corpuscles, which are always very readily coloured, and did not exhibit the well-known granular appearance characteristic of the latter. I infer, therefore, that they were young red-blood corpuscles.

The majority of the red-blood corpuscles of the human subject are certainly not to be coloured by carmine by employing the same process as that by which the white corpuscles are always so readily coloured. The granular or nucleated cor-

puscles of the embryo are readily coloured. The nuclei of the corpuscles of the frog become coloured; but the external portion which is coloured naturally is not tinged by carmine. In winter the capillaries of the frog contain numerous oval corpuscles surrounded by a very thin layer of the external coloured portion, so that they are not more than half the dimensions of the corpuscles when the animal is active. I conclude, therefore, that the nucleus of the frog's corpuscle consists of germinal matter, and the coloured portion of formed material; and that when the animal is active, this formed material is gradually being dissolved away at the surface, while new formed material is produced from within; the oldest part of the formed material being at the surface of the corpuscle, the youngest in contact with the germinal matter from which it was formed.

Of the red corpuscles of mammalian animals, some are destroyed by certain chemical reagents which have scarcely any action on others; and they are not all altered in the same degree or with the same rapidity by the action of water, weak alcohol, syrup, and various fluids, which probably only produce a physical change. Neither do all the particles in a drop of blood undergo the same changes immediately after it has been drawn from the living body.

I think the red corpuscles of man are formed from the germinal matter of the white corpuscles. A particle set free in the current of the blood would appropriate the nutrient material and would grow. During this period it would be coloured by carmine. Gradually, however, the formed material increases, and the germinal matter in the centre dies. The corpuscle now undergoes another series of changes. It begins to be dissolved away at the surface, and at last is, without doubt, entirely converted into substances which are dissolved by the serum, and its place is taken by a new corpuscle.

But the fact which seems to me to prove most conclusively the nature of the mammalian red-blood corpuscle is this:— Guinea-pig's blood, as is well-known, crystallizes very readily in tetrahedral crystals, and, if the process be carefully watched in a drop of blood which has been treated with a very little water, and covered with thin glass, and sometimes even without the addition of water, certain corpuscles will be seen to become angular, and four or eight prominent angles will be observed, while others will exhibit the stellate appearance familiar to everyone. In this remarkable case, then, *the entire blood corpuscle may be seen to crystallize.*

I have seen one corpuscle gradually become one tetrahedron. Now, how can there be a membrane here? The whole process

seems inconsistent with the existence of such a structure. The crystals coalesce and larger crystals are formed; but no membranes can be seen. Two crystals may come into close contact and gradually become incorporated, which could not take place if they were invested with a membrane. It is true, that some of the blood corpuscles are incorporated in the crystalline mass, and may be seen for some time amongst the red crystalline matter, but these are entire corpuscles—I conclude young ones, —not merely cell-walls. These facts permit us, I think, to take a very simple view of the development, nature, and offices of the red-blood corpuscle, which will, I believe, prove substantially true,—but I must apologize for this long digression, and postpone the further consideration of this very interesting question.

In the kidney, and indeed in many other structures, there is the same difficulty in satisfying oneself as to the existence of a cell-wall. The well-defined outline exhibited when elementary parts are placed in water, which is received by many as evidence of the presence of a cell-wall can be exactly imitated artificially. The urea having been separated, filter off a little of the remaining stituents of urine with the extractive matters, and when this solution is moderately concentrated, add nitric acid, so as to be quite sure that no living structures can exist, evaporate the mixture to the consistence of syrup and you will very frequently find a number of bodies, which might be readily mistaken for cells. It would be very instructive to make a series of such artificial products in different ways, for you would find many forms closely resembling the so-called animal cells. Such facts as these, and the changes which he has observed to take place in particles precipitated from fluids, have caused Mr. Rainey to come to the conclusion, I think prematurely, that the growth of bone, and even of some of the soft tissues, may be explained on physical and chemical grounds alone.*

These observations of Mr. Rainey's are most interesting, and most important, and I shall have occasion to refer to them again when we come to discuss the anatomy of bone and teeth, but in all these tissues I have no difficulty in demonstrating the existence of living matter, and without this living matter the tissue never could be formed. Indeed, I may, without fear, assert that, in every living tissue there is germinal matter and formed material. The germinal matter may die,

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* "On the Mode of Formation of Shells of Animals, of Bone, and of several other Structures by a process of Molecular Coalescence, demonstrable in certain artificially formed Products," by George Rainey, M.R.C.S. 1858.

when the formed material has reached a certain thickness; but I maintain that this formed material was, in all cases, once in the state of germinal matter, and could never have been produced except as the result of changes taking place in living particles.

Although in many structures it is difficult to prove the existence of a cell-wall, in others there can be no question as to its presence. In the mildew it is distinct enough; but you may have observed that in the rapidly-growing parts of the plant the layer was exceedingly thin—so thin, that its existence could hardly be demonstrated; while in other specimens the thickness of the formed material was very great indeed. In the first instance the germinal matter was rapidly extending itself. In the last, in consequence, probably, of the existence of conditions adverse to the free growth of the plant, the germinal matter had slowly undergone conversion into formed material —a certain amount of nutrient matter was absorbed, so that the whole mass had increased in size,—but had the conditions been favourable, many times the quantity of formed material would have been produced in the same period of time, but this would have extended over a very much larger surface, and of course a very much larger proportion of germinal matter would at the same time have been formed.

I need not detain you by describing the *cell theory*, as generally received in the present day, for no doubt you are all well acquainted with the doctrine. I have endeavoured to show that in some instances a cell-wall exists, and that in many there is no cell-wall at all, while in others it is impossible to distinguish between the cell-wall and the so-called cell contents. The idea of Schleiden, accepted by Schwann, that the nucleus was precipitated from a fluid like a crystal, and the cell-wall afterwards deposited around it, has been often contradicted by actual observation, and it is difficult to see what object could be fulfilled by such a process.

A modification of Wolff's view has lately been strongly advocated by Prof. Huxley, and has been made by him to harmonise with the notions entertained with regard to the nature of the intercellular substance. It is supposed that originally a clear homogeneous plasma is produced, in which spaces (vacuoles) are formed, and these contain, in the interior, the endoplast, consisting in fact of the primordial utricle of the vegetable cell, the cell contents, and the nucleus.

The walls of these spaces are composed of the original plasma altered, which is termed the *periplast*, or periplastic substance. The greatest importance is attached to the periplast. It is

supposed to possess the active power of growing in and forming partitions, when division of the endoplasts occur, and of becoming differentiated into very important structures. The intercellular (periplastic) substance is considered throughout Germany as a most important structure, and it is generally believed that its peculiarities are not dependent upon the cells it contains, but are due to powers residing in it. Mr. Huxley's views may be gathered from the following extract :—" The endoplast grows and divides ; but, except in a few, more or less doubtful cases, it would seem to undergo no other morphological change. It frequently disappears altogether ; but, as a rule, it undergoes neither chemical nor morphological metamorphosis. So far from being the centre of activity of the vital actions, it would appear much rather to be the less important histological element.

" The periplast, on the other hand, under the names of cell-wall, contents, and intercellular substance, is the subject of all the most important metamorphic processes, whether morphological or chemical, in the animal and in the plant. By its differentiation, every variety of tissue is produced ; and this differentiation is the result, not of any metabolic action of the endoplast, which has frequently disappeared before the metamorphosis begins, but of intimate molecular changes in its substance which take place under the guidance of the ' vis essentialis,' or to use a strictly positive phrase, occur in a definite order, we know not why."

Virchow, on the other hand, attaches the greatest importance to cells, which always come from cells, but believes, nevertheless, that, " It is not the constituents which we have hitherto considered (membrane and nucleus), but the contents (or else the masses of matter deposited without the cell, *intercellular*), which give rise to the functional (physiological) differences of tissues." The cell is " a simple homogeneous and very monotonous structure, recurring with extraordinary constancy in living organisms." It is the other contents, not the nucleus or membrane, which occasion the physiological action of parts. Virchow considers that the nucleus is concerned in maintaining and multiplying living parts, and that while fulfilling its functions it remains itself unchanged.

Dr. Hughes Bennett, of Edinburgh, holds, on the contrary, that cells can grow from a clear exudation, and he considers that granules first make their appearance, and that a cell-wall is afterwards formed around these.

It is very difficult to express briefly the differences and resemblances between all these conflicting views ; and it would

be quite out of place, in a course like the present, for me to show in detail the several points in which I agree with, or differ from, those who have written before me. I hope, therefore, these authorities will not think I am treating them with disrespect if I allow the points of difference to appear from time to time as they naturally arise, instead of devoting much space to mere controversional writing, which could fulfil no useful purpose.

My own conclusions do not permit me to agree with any of these theories. I have already alluded to the difficulty of demonstrating the existence of a cell-wall, and have shown that this is not a constant structure. So far from regarding the intercellular substance as the seat of essential changes, I shall endeavour to show that it is the least active part of the tissues, and that it does not possess formative power at all. Neither do I think that cells effect any alteration in the substance external to them. Living structures are, I believe, quite incapable of exerting any important action on matter at a distance from them. I cannot think that the cell (elementary part) can be formed from a fluid exudation, but believe with Virchow, that in all cases cellular elements must have existed wherever cells are found. I believe that every organic compound in the body was once living, or was derived from a living structure. Albumen in the blood, as such, is not living, but it has been formed by living matter, and may again become living, if appropriated by a living structure.

Let us enumerate a few of the appearances connected with the structure of elementary parts which may be readily demonstrated, and for the explanation of which we are endeavouring to frame a theory. If what I have said with reference to the characters of germinal matter, and the order in which growth takes place, be true, as I hold it to be, for every living structure, any theory proposed should be equally applicable to all these different phenomena; and if it will not account for them it should at least not be incompatible with any one.

1. The presence of a distinct membrane (cell-wall), permeable to fluids, forming an investment to each elementary part, and containing within clear transparent or granular matter, at rest or in motion.

2. The absence of any such membrane over every part of the surface, so that protrusions occurring from different parts extend to a considerable distance, and where they come into contact, coalescence takes place, and then the most varied forms are produced.

3. A very thick external investment, perfectly homogeneous,

granular, or in distinct layers, varying in thickness and density, or resembling each other in these particulars.

4. The formation of insoluble substances, as well as the presence of matter in solution amongst the living matter within the external membrane.

5. The presence of a large or small quantity of a peculiar material, homogeneous, granular, deposited in laminæ, or fibrous (intercellular substance), between the so-called cells or nuclei.

6. The absence of such a structure.

7. Elementary parts with nuclei and nucleoli, or destitute of both.

8. The formation of fibres projecting from the envelope of the elementary part.

9. The formation of fibres clearly prolonged from the substance of the elementary part, and composed of the same structure.

10. Elementary parts may begin their existence as minute masses of granular (germinal) matter. At a later period a membrane may be demonstrable. Afterwards the membrane may become very thick indeed, so that a small cavity alone remains in its centre.

I might very much increase the length of this already long list, but it is, I think, sufficient to prove that the doctrines at present taught will not explain all the phenomena which are observed; indeed, some of the facts mentioned are altogether incompatible with the favorite theories now entertained.

. An elementary part may commence its existence as a very minute granule,—too small to be seen even with the highest powers. It grows, and then exhibits an outer portion of different character to the material within. Changes may then occur in the inner material. Small bodies may appear, from which new growth may proceed at a subsequent period, and within these smaller particles may be evident. These clearly arise one within the other. The central mass may divide, and the resulting portions may divide and subdivide until an immense number of masses are produced. These may be quite separate from each other, or they may be included within the original capsule. In other cases there is no capsule, and the division and subdivision take place in a transparent, and more or less viscid substance, which lies between each resulting mass. In all cases the whole mass, and each component particle, consists of *germinal matter* and *formed material*. The latter forming a hard or soft external envelope, varying in structure,

or a fluid or viscid substance external to the *germinal* matter, and sometimes also deposited amongst it.

The power of growth of the germinal matter of man and the higher animals, like that of the lower, is, there is reason to believe, quite unlimited. Although this cannot be proved absolutely, I shall bring forward facts which justify me in this statement. The conditions necessary for the growth of the germinal matter of the tissues of the higher animals are, however, so complicated that the vitality of the germinal matter is much more easily destroyed, and it is therefore more difficult to study the alterations produced in the elementary parts, by modification of the circumstances under which they grow; still, by a minute examination of the morbid changes occuring in tissues in disease, or induced artificially, most important general conclusions have been arrived at, and there is the greatest encouragement to continue the same course of investigation.

Let me now show one or two specimens illustrating the character of healthy elementary parts of different ages, from the more complex tissues; and afterwards I shall show you some which are modified by the altered condition under which they have grown.

If we examine the elementary parts near the vascular surface of the skin, or a mucous membrane, we shall have no difficulty in convincing ourselves of the following facts:—

1. That they are much smaller than those near the surface.

2. That, although very small, the proportions of the *germinal matter* to the *formed material* is very much greater than in the older elementary parts.

3. That the formed material gradually increases as the elementary part grows towards maturity, the germinal matter absolutely increasing; but in proportion to the formed material it is relatively diminished.

After the elementary part has reached maturity, and has advanced some distance from the vascular surface, where it commenced its existence, the outer part of the formed material perhaps shrinks and becomes harder and drier, while the germinal matter gradually undergoes conversion into new formed material, until the proportion becomes very small, and the remainder, now at a long distance from the vascular surface, and separated from any nutrient matter by a hard dry mass of formed material, as, for instance, in the cuticle, dies.

No. 17 (sent round at the close of the last lecture) shows a portion of the epithelial covering of a papilla from the tongue of a girl aged ten years. This is to illustrate the growth

of the epithelium.   The deepest layer consists of masses of
germinal matter separated from each other by a very thin layer
of *formed material,* which is not coloured by the carmine. These
are for the most part spherical or oval, some are undergoing
division into two.   The formed material of the deepest series
is seen to be continuous with the formed material of the dermic
structure.   At the outer part, elementary parts are seen
which occupy as much space as six or eight of the youngest
ones.   Each contains a dark red mass of germinal matter, larger
than that of the youngest particles, but bearing a proportion to
the entire elementary part considerably less than that belong-
ing to the youngest particles.   It is, therefore, clear that in
the growth of these elementary parts the germinal matter and
the formed material have both increased.   The whole of the
nutrient matter absorbed, has passed through the stage of
germinal matter, and become formed material which has
gradually accumulated.   The   oldest elementary parts are
removed from the specimen, but the proportion of germinal
matter gradually diminishes, and in the hardened scales which
are about to be cast off not a trace can be shown to exist by
soaking in carmine.

The rapidity of division of the germinal matter near the
nutrient surface, and the formation of new elementary parts
is especially influenced by the amount of nutrient matter
present.

No. 18 is a thin section of the tongue of a fœtus at the
seventh month.   The arrangement of the muscular fibres is
well seen, and the papillæ are already developed as little simple
elevations from the general surface.   All the tissues consist
principally of germinal matter, and in every part of the
specimen the number of these masses coloured by carmine is
remarkable.   The interval between the mucous membrane
and the point of insertion of the muscular fibres corresponds
to the corium and submucous tissue of the adult tongue.   It
is occupied entirely by oval nuclei, many of which are observed
to be in lines, and these can be shown to be connected with
the capillary vessels and nerves.   No fibrous appearance what-
ever exists, and the quantity of formed material existing in
connection with the germinal matter is very small.

Now contrast this specimen of the tongue of a fœtus at the
seventh month, with No. 19, which is a corresponding section
from the tongue of a child ten years of age.   They are under
the same magnifying power.   In the first you could see eight
papillæ in the field at once with the submucous tissue, and
many bundles of muscular fibres.   In this specimen you can only

see three papillæ, and a layer of submucous tissue and corium five or six times thicker than that in the fœtal tongue. The field is only large enough to take in just the pointed insertions of the muscular fibres, although the epithelium has been entirely removed, which greatly diminishes the thickness of the specimen. The masses of germinal matter are numerous in the simple papillæ, of which the three large ones in the field are composed, but in the base of the large papillæ, and throughout the corium a number of transparent spaces or areolæ are observed, which are bounded by lines of small oval particles of germinal matter, the so-called nuclei of the areolar tissue. The space which looks so transparent is occupied by a tissue which possesses a fibrous appearance, which is firm and unyielding, and which yields gelatine by boiling. The whole of this tissue is generally called connective or areolar tissue, or "bindegewebe," and those nuclei which you see bounding the transparent spaces have been christened areolar or connective tissue corpuscles. They are supposed to take part in the nutrition of this structure, which does not exist in the embryo, but which increases with age, and undergoes condensation as life advances. In my sixth lecture I shall discuss at some length the connective tissue question, but let me now direct your attention to the fact that many of these corpuscles are connected with arteries, veins, capillaries, and nerves, and there is reason for believing that some of the more spherical particles, coloured red by the carmine, are lypmh corpuscles in the lymphatic vessels, and white blood corpuscles in the capillaries. Notice the linear arrangement of these bodies in the papillæ, external to the capillary vessels, and immediately beneath the epithelium. These I shall show are undoubtedly connected with nerve fibres, and from their position, it follows that if the capillaries were congested, these corpuscles would be subjected to slight pressure. In the areolar tissue there are also a number of masses of germinal matter, which are converted into fat cells.

Lecture IV.

*Of the Increase of Elementary Parts. The effects of the
condition under which they grow being altered—of Pus—
of Morbid Growths.*

Mr. President and Gentlemen,—

I have endeavoured to show that the elementary parts of
every tissue, which in many cases are termed cells, may be
considered to consist, like the simplest living structures, of
matter in two states, *germinal matter* and formed *material,* and
that constant change is incessantly taking place in every
elementary part. The matter to be animated passes into the
interior, and becomes living germinal matter, while a corre-
sponding portion of that already existing as *germinal matter*
becomes *formed material.* In many instances, a correspond-
ing proportion of this formed material is broken down and
removed.

Thus it is possible that an elementary part may be the seat
of the most active changes, although it undergoes no alteration
in its physical characters, or in its appearance, when examined
by the microscope. I tried to show that, in some cases, a
distinct investing membrane (cell-wall) exists, while in others
there is no such structure. It is therefore not essential. The
greatest confusion has resulted from attempts to distinguish
in all cases the so-called cell-membrane from the cell-contents.
In very many cases no such distinction can be made. By carmine
we are enabled to decide in every instance which is the germinal
matter, and which is the formed material. Neither the liver

nor the kidney elementary parts, are surrounded with a membranous wall, and in most of the tissues of the higher animals no such structure is to be seen. I brought forward several important facts to show that even the red-blood corpuscle could not be regarded as a cell with perfectly fluid contents, through the membranous walls of which endosmose and exosmose were continually taking place. Neither the cell-theory as introduced by Schleiden and Schwann, nor any modification of it, that has been proposed, nor the view advocated by Professor Huxley will account for all the appearances which are actually observed. If we study the manner in which each elementary part of a tissue grows, and compare the elementary parts of different tissues with each other, after they have been soaked in carmine, we come to the conclusion that the inner part (germinal matter) coloured red, is the active growing portion, and that the outer part (formed material) which is not coloured, is formed from this. The oldest part of the formed material is that which is most distant from, and the youngest part is that which is in immediate contact with, the germinal matter. The formed material exhibits the most different characters, and possesses the most different properties in different elementary parts, but in all cases its relation to the germinal matter is the same.

We now pass on to consider briefly some very interesting changes, which may be shown to occur in elementary parts, when the conditions, under which growth takes place in a normal state, are modified.

No. 20. This preparation shows the elementary parts situated in the middle of the cuticle of the arm, about twelve hours after the application of a blister, at the time when the superficial layers were being separated from the deeper ones, and fluid was accumulating in the interval between them. In the part of the preparation now shown, several elementary parts are seen invested with a moderately thick layer of formed material, but to the left of the field are some having but a very thin layer indeed. Several spherical masses of germinal matter are observed in close contact with the inner surface of the softened external substance, and these are evidently in a state of active growth. They seem to be growing through the formed material. They are multiplying in number. If set free, and nutrient material continued to be abundant, they would soon increase in size, and multiply very fast. The layer of formed material, investing each, would be exceedingly thin. The masses first resulting from the growth of the germinal matter set free from the epithelial particles would be invested with a layer of formed material, and would resemble a young

cell of cuticle, but as they multiplied faster and faster, there would not be time for the formation of the layer of *formed* material, and at last corpuscles resembling pus would result.

This last stage is seen in No. 21, which was obtained from the same blister twenty-four hours after it had risen.

These specimens are most important, as they show the manner in which the formed material is produced, and how, under certain altered conditions, the germinal matter may increase quickly, and a vast number of separate masses may be rapidly produced. The preparations also prove, that the thickness of the layer of formed material (cell-wall) is determined by the rapidity of increase of the germinal matter, which, in great measure, depends upon the proportion of nutrient matter present.

If the germinal matter of a structure grows unusually quick, particles resembling the pus corpuscle, which contains very little formed material, are produced. Conditions favourable to the rapid increase of germinal matter are adverse to the formation of formed material. The formation of pus from epithelial cells, has been demonstrated by Virchow; but he does not seem to have observed the alteration in the proportion of the germinal matter (nucleus) to the formed material (cell-wall) alluded to. He attaches by far the greatest importance to the formation of pus in the areolar tissue corpuscles; and considers that from these bodies various morbid processes which may affect other tissues start.

It seems to me, that the first stage is the more rapid multiplication of the elementary parts, and the formation of a diminished quantity of formed material,—the *tendency* being towards the production of similar elementary parts, but this being prevented by the abundance of nutrient material, and the rapid increase of the germinal matter. When we consider fibrous textures, I shall show you a specimen in which only soft spongy fibres are formed; and, if the process went on, the fibrous material would be less and less, until the rapidly-growing spherical masses of germinal matter were produced. There can be no doubt that germinal matter may even grow and multiply, so to say, at the expence of its own formed material.

Virchow considers, that two different modes of pus formation must be distinguished according as the pus proceeds from epithelium or from connective tissue. "Whether there are also forms of suppuration, proceeding from tissues of the third class, muscles, nerves, vessels, &c., is at least doubtful; because of course the elements of connective tissue which enter into the composition of the larger vessels, the muscles, and the

nerves, must be eliminated from the really muscular, nervous, and vascular (capillary) elements. With this reservation, we can for the present only maintain the possibility of two modes of pus-formation." Neither does Virchow appear to have recognized the tendency of the germinal matter, of tissues—the cornea, for instance,—to form, under certain conditions, soft fibres, which are produced more rapidly than the perfectly normal structures—this tendency, diminishing as the rapidity of multiplication increases, until at last pus is formed. In a preparation of Virchow's of the cornea in acute keratitis, in the possession of Mr. Spencer Wells, the particles of the germinal matter are seen increasing and multiplying in the same way as I described in the epithelial cells of the cuticle. They are growing at the expense of the softened formed material which surrounds them, but in adjacent parts, where the changes are occurring more slowly, the tendency to the formation of new elementary parts can be seen. As will be seen in Lecture VI, my views differ totally from those of Virchow with regard to the structure of the so-called connective tissues and the relations of the cells to the intercellular substance.

Pus is not a special formation always produced from the same substance or in a particular kind of cell, but it may result from the germinal matter of any tissue, and its characters are modified to some extent, according to the circumstances to which I have already alluded.

I believe that the living germinal matter of an elementary part may be set free by the destruction of the formed material, as in a scratch, perforation by the sting of an insect, or other mechanical injury, or by softening of the formed material, caused by an alteration occurring in the composition of the fluid which bathes it, or induced artificially by various chemical compounds. When germinal matter comes into contact with nutrient material under favourable circumstances its power of infinite multiplication becomes apparent. Inanimate matter near it is absorbed by the several particles, and their active powers are communicated to it. If the nutrient matter be very abundant, the particles will consist almost entirely of germinal matter; but if not very abundant, time will be allowed for the formation of a certain amount of formed material. The germinal matter of any tissue in the body is capable of growing in this way. Every particle of germinal matter possesses the power of infinite growth. Whether a texture with a smaller quantity of formed material than in the normal tissue, and hence a soft spongy tissue, or a mass composed almost entirely of small spherical masses of germinal matter (pus corpuscles) is to be

produced, will depend mainly upon the quantity and character of the nutrient matter. If we look at suppuration in this light, the cause of the different characters of pus becomes evident. The germinal matter of any tissue in the body may grow infinitely. In the normal state it multiplies under certain restrictions, and as it grows, the formation of formed material gradually proceeds, and the germinal matter becomes separated further and further from the nutrient fluid. The formed material is prevented from undergoing any but slow change; and the removal of the small quantity of products resulting from this change is sufficiently provided for. But if the germinal matter be set free, active changes immediately commence, the inanimate nutrient matter around is soon taken up and becomes living, and the process will continue as long as the above conditions last. And if this were not the case, what would happen? Why, clearly the fluids set free, prevented from undergoing the incessant change which is provided for in the normal state, would rapidly putrefy, and the products resulting from the putrefactive changes would soon cause the death of the tissues immediately surrounding. The process would go on, and a considerable quantity of tissue would be destroyed, and the death of the whole organism would result. In gangrene, the germinal matter is killed; in suppuration it grows freely, and if this process did not occur, there are cases in which the death of the tissues must result.

At the high temperature of the higher vertebrate animals, moist organic matter, in which the fluid is not perpetually changing, rapidly putrefies; but in the lower cold-blooded animals the putrefactive change occurs very much more slowly, and hence there is not the same necessity for the rapid conversion of the dead tissue into living germinal matter. In them, the process which we know as suppuration does not take place, the changes, although they are the same in their essential nature, do not go to the same extent. I have specimens of the growing elementary parts of the cuticle of the frog, after injury, which correspond exactly with those from the human skin which I have just shown you.

No. 22 is a preparation of pus, several corpuscles of which are well-coloured by carmine. I have not succeeded in colouring all, for this structure is so delicate, and undergoes such rapid disintegration in fluid, that it is difficult to make the fluid sufficiently limpid to pass easily into the interior of the corpuscle without causing its disintegration. All fresh pus corpuscles are, however, capable of being coloured.

Compare this specimen with No. 23, which is a preparation

showing the elementary parts of a rapidly-growing fungus, which reached the size of a small pear in a single night. It is difficult to see any membrane of formed material surrounding each mass of germinal matter. The rapid increase of such a structure is marvellous, but it cannot live long, because there is no provision for the equable distribution of nutriment to all parts, or for removing the substances resulting from the death of the particles of germinal matter. The consequence is, that the entire structure, having reached a certain size, very soon dies.

The free growth of the germinal matter in such cases is very interesting; and the readiness with which we can, by the action of colouring matters, distinguish the germinal matter from the formed material, will, I think, enable us to regard various morbid changes which appear now very complicated, from a much simpler point of view.

From the examination of the above specimens, it appears that the germinal matter of elementary parts growing under certain conditions different to those existing generally, will, if pabulum be abundant, multiply very freely. A number of masses result, each of which is capable of producing new ones by division, but only a very thin layer of formed material investing each will be produced, or it may not be possible to demonstrate an investing membrane at all. On the other hand, masses of germinal matter which, in the normal state, multiply very rapidly, and are therefore not surrounded by formed material, may produce it, if placed under circumstances not favourable to their free increase. The white blood corpuscle, in a state of rest, and freely supplied with nutrient matter, may even form weak fibres. In coagula of fibrin, I have seen white corpuscles from the surfaces of which fibres of considerable length projected, and I could see no reason for doubting that the relation of this fibrous material to the germinal matter was the same as in other structures. I have seen white blood corpuscles entangled in the coagulated transparent matter of the casts of the uriniferous tube, undergoing multiplication, and in the same case I found between the capillary loops and the membranous capsule of the Malpighian body, some long soft fibres, with a body in the centre exactly resembling a white blood corpuscle. White blood corpuscles had accumulated considerably in the capillaries in every part of the kidney in this case.

In very recent lymph effused on the surface of serous membrane are masses of germinal matter, many of which are connected with the soft recently formed fibres. I believe that

the fibres in this recent lymph consist of the formed material of the so-called corpuscles. I am still making observations on this matter, especially with reference to the question, how far a similar view may account for the formation of fibrin under ordinary circumstances. I believe that fibrin is the formed material of the white corpuscles, lymph, and chyle corpuscles. In false membranes of very recent formation, I have demonstrated the existence of numerous masses of germinal matter, in connection with the fibres and in the specimens which I have examined I feel sure that the fibres consist of the formed material of these masses of germinal matter, and that they bear to the corpuscles or masses of germinal matter, the same relation as the formed material of the different tissues. The masses of germinal matter (nuclei) are as numerous as in tendon.

So that germinal matter may multiply very fast, and produce less formed material than in the normal state, or germinal matter, which in the normal condition produces very little formed material may be placed under circumstances in which a considerable quantity of formed material is produced. It is therefore very essential to study the conditions which effect these very striking modifications in the germinal matter of different structures.

No. 24 shows the relation existing between the germinal matter and formed material of the tendon of a kitten, and in

No. 25 the germinal matter and the formed material of the true skin from a fœtus, at the 7th month, are seen.

The first is a structure, in which the changes are exceedingly slow ; the second is one in which we know changes are occurring constantly, and with comparative rapidity throughout life. You will admit, I think, that in all probability the germinal matter, in the one preparation, corresponds to that in the other, —fibrous tissue being the result of the growth of the germinal matter of the tendon,—nerves, capillaries, fibrous, elastic, and adipose tissues being formed from the particles of the germinal matter in the last specimen. The relation of the germinal matter to the formed material, in quick and slow growing tissues, is well seen in the fœtus, from the 6th to the 9th month.

No. 26 shows the bulbs of two or three hairs from the foot of a kitten. The bulb is much wider than the shaft of the hair. The elementary parts, in this region, are composed almost entirely of germinal matter. Higher up the formed material increases, and each elementary part undergoes condensation. Much of the water of the elementary parts is absorbed, and the whole, consequently, contracts and becomes firmer. The manner in which the formed material is produced is seen very

beautifully by examining the elementary parts at different heights in a specimen of hair prepared with carmine. According to the language generally employed, the nucleus gradually diminishes while the cell increases in extent, as we ascend from the deep part of the bulb, upwards towards the shaft, until, when we arrive at the dry part of the hair, the cells (cortex) are destitute of nuclei. The nature of the change is explained very simply by the view which I am advocating, and follows of necessity, because the supply of nutrient material to the elementary parts gradually diminishes from below upwards.

No. 27 is a thin section from a tumor which grew very rapidly. It appeared at the lower angle of the scapula of a boy, aged 12 years, and when first noticed was about the size of a bantam's egg. In six months it measured twenty-seven inches in circumference. It was firm and hard, and was intimately adherent to the scapula. The case occurred in the practice of my friend, Dr. Elin, of Hertford, to whom I am indebted for the specimen. The friends would not consent to have the mass removed, and it continued to grow for about twelve months after its first appearance, when hœmorrhage occurred from some large veins on the surface of the tumor, and the boy died of exhaustion. The mass was of the same character throughout. Dr. Elin says : " It surrounded the scapula which was partly absorbed. The bone was very brittle, breaking like a piece of glass. I have no doubt that the tumor originally spread from the periosteum of the margin of the scapula." An aunt or cousin of the boy seems to have died of a similar tumor several years ago. The relation of the germinal matter to the formed material is well seen in this specimen, and the free but irregular mode of growth of the elementary parts is also well shown.

No. 28 is a section of tumor, about the size of a walnut, connected with the parotid gland. The remains of some of the gland-follicles are seen, and as the elementary parts in them are dead, and are undergoing disintegration, they are not coloured by the carmine. On the other hand, the actively growing tissue contains a large amount of germinal matter, every separate mass of which is darkly coloured. The growing tissue insinuates itself in every direction, and where the parts of the growth first formed are becoming old and are losing their vital activity, offsets from the more recently developed parts, may be seen invading them.

No. 29 is an interesting specimen of the so-called cancer-cells, which were passed in the urine of a patient suffering cancer of the uterus.

In these morbid growths we have no difficulty in demonstrating the existence of germinal matter and formed material, and even cursory observation of the tissue affords abundant evidence of its wonderful power of rapid growth. Although it would not be possible to distinguish a single elementary part of one of these growths from an elementary part removed from certain healthy tissues, the striking irregularity of the structure, the absence of that orderly arrangement exhibited by all healthy textures, and the great extent of tissue exhibiting precisely the same characters, afford conclusive evidence as to the nature of the structures under consideration.

If the elementary parts of a tissue multiply to an unusual extent, and thus overstep the limits assigned to them in the normal state, a growth is produced which may only differ from the healthy tissue with respect to its bulk, with reference to the position which it may occupy or to which it may spread, and in the relation it bears to other textures. Adipose tissue, fibrous tissue, cartilaginous and bony tissues often form tumors of considerable size in direct continuity with the normal structure. It would seem that just at the point where these outgrowths originate, the restrictions under which growth occurs normally, are to some extent removed, and here we see the power of unlimited growth, which is a property of the germinal matter of all tissues, manifesting itself.

In the normal state there is reason to believe that, of the nutrient material distributed to the tissues, a certain proportion is absorbed by the germinal matter, and at length undergoes conversion into tissue, while any excess is probably taken up by lymph corpuscles, and, perhaps, by the white blood corpuscles, which increase in number, and is at length restored to the blood. It is probable that, in many of the textures in the interior of the body, a balance of nutrition is thus maintained in the healthy state. If, however, the active powers of the germinal matter of the tissue be impaired, in consequence of some inherent deficiency, or through the influence of a pabulum not fitted for its nutrition, or by some change in the formed material which separates the germinal matter from the nutrient fluid, the tissue must suffer; and, as new material is not added to it as fast as the old is removed, it must waste. In this case a large proportion of the nutrient matter will be taken up by lymph corpuscles, which will rapidly increase in number, and the pabulum, which ought to have been made into tissue, will be again restored to the blood.

It seems not unreasonable to assume that a result, corresponding to that which is effected in the skin by the removal of

the superficial layers of the cuticle and hair, and by the escape of the secretion of the sebaceous and sudoriparous glands,—in mucous membranes, by the falling off of the superficial layers of epithelium,—and in glandular organs by the conversion of formed material into the secretion, is brought about in tissues distant from such surfaces as the muscles, nerves, and some other textures, by the little masses of active germinal matter known as the lymph and white blood corpuscles, and thus the debris is again restored to the blood, to be resolved into matters which may serve as pabulum, and compounds which must be eliminated. I must not, however, pursue this part of the question further, just now, and will only offer the suggestion that in certain cases, where an unusual growth of the tissue takes place at a particular point, it is just possible that here the arrangement, through the influence of which the tissue is maintained within its proper limits in the normal state, and prevented from extending indefinitely, is absent.

Lecture V.

Of Morbid Growths.—Of the Development, Growth, Nutrition, Decay, and Removal of Tissues.—Of Secretion.—Of the Changes occurring in Living Matter.

Mr. President and Gentlemen,

When we were considering the changes occurring in elementary parts during their growth, we saw that the proportion of the germinal matter to the formed material altered as the elementary parts increased in size. At first each consists of a mass of germinal matter, which is separated from its neighbours by a very thin layer of soft formed material. At this period of its life it may divide and subdivide, and several separate masses may be produced. Gradually, however, as each elementary part recedes from the vascular surface, the germinal matter ceases to divide and subdivide, although it still absorbs nutrient material and grows. Inanimate matter becomes germinal matter, and germinal matter becomes formed material. At last, when the elementary parts are separated by a considerable stratum of younger ones from the nutrient surface, the formed material becomes harder and drier, and less permeable to moisture. The changes taking place in the germinal matter, now imprisoned in a firm thick layer of formed material, occur more slowly. It still lives, and slowly diminishes as its outer portions become converted into formed material. At last the conditions, under which it is placed, become so altered, that it dies, and perhaps becomes liquified. A small space remains and marks its original situation.

The rate of multiplication of the masses of germinal matter seems to depend principally upon the quantity of nutrient material in contact with them. If this be very abundant they multiply very rapidly; while, if it be scanty, they increase in number very slowly. Rapid multiplication of the masses of germinal matter is constantly associated with the presence of a large amount of nutrient matter, and the production of a very small proportion of formed material.

Elementary parts which, in the *normal* state, become surrounded with a moderate thickness of formed material, may multiply very rapidly under conditions which render the production of formed material impossible.

Thus the young elementary parts (cells) of cuticle may grow more quickly than usual, and at last masses of germinal matter, destitute of formed material, growing and multiplying rapidly, may be produced. Pus corpuscles are thus formed; but before absolute pus is produced, there is always manifested a tendency to the development of such elementary parts as are met with in the normal state.

I have referred to the orderly arrangement which the elementary parts of all healthy tissues at every period of existence exhibit, and have shown that in certain morbid growths no such order exists, — that in healthy organs there is a provision which prevents the different tissues, of which they are composed, from overstepping the limits which are assigned to them, while, in morbid growths, no such restrictions exist, and the power of infinite growth, which the germinal matter possesses, becomes apparent.

The difficulty of discussing many of these important questions is much increased by the very guarded manner in which writers are in the habit of expressing themselves. The obscure language often made use of, and the complicated words, the definition of which is continually changing, not unfrequently render it a matter of great labour to the reader to form any accurate idea of the exact opinion which the author holds. In endeavouring to avoid these objections, by expressing myself simply, and without making use of the terms generally employed, I am well aware that my views will be fully exposed to the attacks of opponents, and any errors not being screened by ambiguity of expression, will be at once discovered; while I may also be open to the charge of being presumptuous, and shall thus, when in error, necessarily incur double censure.

Still, by pursuing this course, it is obvious that free discussion will be much facilitated, and the truth will, in all probability, sooner be discovered. To this everything should

be made to give way, and personal interests must be absorbed in the general advantages which must result from efforts to facilitate the progress and diffusion of scientific truth.

An abnormal or morbid growth may originate in any tissue in the body. If it commences in a tissue of simple formation, it will retain, to a great extent, the character of this structure, but if it arise in one of the higher tissues it will soon become so modified that it would not be possible to determine its origin from its microscopical characters.

The character of a morbid growth will, therefore, in great measure, depend upon the tissue in which it originated. Not unfrequently it would be quite impossible to distinguish a section of a morbid growth from one of the healthy tissue in which it commenced. In other cases an important modification in the elementary parts will have taken place. The muscular fibre cells around the pylorus, and in other parts of the intestinal canal, sometimes increase enormously in number, leading to the formation of a firm unyielding tissue, which is almost as firm as fibro-cartilage (sometimes described as scirrhus of the pylorus). As the contractile element increases, it loses its contractile power, and the whole mass appears to be composed of a form of fibrous tissue, in which the separate fibres are very distinct, and arranged parallel to each other in concentric layers.

I shall be able to show you a specimen of a healthy structure in which the contractile elementary parts of organic muscle are seen, at the margin of the bundles, to shade into those of fibrous tissue. Up to a certain period the germinal matter of these might have produced organic muscle, but the contractile tissue not being produced, a lower form of tissue is as it were formed in its stead. Since such a transition may be demonstrated in the healthy state, we shall not be surprised at finding what amounts to a very exaggerated change, in disease. The elementary parts have multiplied enormously, but they have developed, not their characteristic contractile tissue, but a lower and simpler form of *formed material*, not possessing the peculiar endowments of the normal structure.

If the restrictions, under which a soft healthy tissue grows, be removed, a soft and often very rapidly growing structure results.

Those structures which in the healthy organism grow fastest, and pass most rapidly through the various stages of their existence, as would be supposed, give rise to the formation of the most terrible and uncontrollable of morbid growths. An irregular growth of a part of the secreting structure with the

vessels, for instance, of the liver, kidney, mamma, sweat glands, &c., may lead to the formation of a very soft, spongy, and highly vascular growth, which will attain a very large size, and appropriate the nutrient material which properly belongs to other textures. After a time, perhaps, it reaches the surface of the body, and fatal hæmorrhage may take place from its superficial vessels. In many such morbid growths we can distinguish the elementary parts which have descended from those taking part in secretion, although they have become much modified, from the elementary parts which are connected with the vessels prolonged into the structure. The former constitute the ' cells,' or ' cellular elements' of the morbid growth, and the latter with the vessels themselves, form the ' matrix,' or walls of the areolæ or spaces in which the cells lie.

When we consider what a very slight derangement of the elementary parts at an early period of development would infallibly lead to the suppression or exaggeration of normal structures, which are their direct lineal descendants, is it not wonderful that morbid growths (irregular growth of one or more tissues) or monstrosities (exaggeration or suppression of series of elementary parts from which numerous different tissues, entire organs, or limbs, are produced) are not of yet more frequent occurrence than they are?

Many healthy structures may be removed from the part of the body where they have been developed, to a distant part, and will nevertheless grow there. Skin, hair, teeth, and other tissues have been successfully transplanted, but perhaps the most interesting, and not the least useful, instance of this kind which could be adduced, is the transplantation of growing bone. M. Ollier has removed a portion of the periosteum from a bone, and planted it in a distant part of the body,—under the skin for instance,—and bony tissue has been produced. The periosteum contains bone germs, which only require nutrient material to undergo development into ordinary bone. The practical surgeon will, of course, soon apply so important a discovery to the treatment of certain cases. Some textures retain their vitality after they have been separated from the parts where they grew, for a much longer period of time, and have a much greater power of resisting destructive agencies, than others.

In some of the lower animals, so active is the tendency to growth, and so strong the power of resisting what would seem to be adverse conditions, that mechanical separation into numerous parts serves but to increase the rapidity of the production of separate independent organisms.

When we consider how very greatly the normal tissues of the higher animals vary in structure, properties, and power, we shall not feel surprised at the great differences observed in the morbid growths which originate in them. Some of these grow very slowly, others very rapidly—some form circumscribed and comparatively isolated masses, while others burrow in every direction, invading every tissue in their immediate neighbourhood, and growing at its expense. A part of a morbid growth may be cut off from nutrient material by the growth of the rest, and may die. Into this dying or dead portion, part of the living mass may grow, and, as it were, live upon the very tissue which once formed a living part of the whole, and of which, in fact, the last is a direct extension.

The larger the growth becomes the greater seems to be its powers of resistance, and the more readily do the normal structures yield to its advance. The least particle of it will spread rapidly, its increase appearing to be limited only by the supply of nutrient material. The faster it grows the more irresistible the power of growth seems to become, and, especially in cases where the growth is composed of a number of loosely connected portions, even a very small piece detached and carried to a distant part will readily grow. In not a few cases a very minute portion of the germinal matter of one of these structures may be carried away to a distant part of the body, and so powerful is its tendency to animate any form of nutrient matter in the organism,—so unrestricted the conditions under which it grows, and so increased is its power of resisting the action of conditions which would doubtless have destroyed the germinal matter from which it originally sprung,—that it will grow wherever it may chance to become stationary. An elementary part or even a little of the germinal matter may be detached from the original mass, and removed to distant parts by the movement of organs one on the other, or it may be carried a long way from the point where it originated, by the lymphatic vessels, and, there can be little doubt, by the blood vessels also.

These morbid structures may ultimately be found growing in connection with healthy tissues with which they have no characters in common. A bone-germ, detached from a soft, rapidly-growing, spongy, bony tumor may take root even in the pulmonary tissue, and thus several hard solid separate masses of bony structure, which may attain considerable size, may grow in different parts of the lung.

In all these cases the vessels grow with the other elements of the tissue, and thus the conditions for unlimited increase

without order, in an irregular manner, and without advantage to the organism, are present, and may persist. These results appear to depend more upon the circumstance that the restrictions under which the growth of the tissue occurs normally, are removed, than upon any special peculiarities of the morbid growth itself. The conditions favourable to the development of such structures are not the result of accident, but depend upon changes which have occurred at an earlier period of time, and these may, in the same manner, be referred back. The hereditary nature of many of these growths, and the symmetrical character of certain morbid processes, receive something like an explanation from the view I have taken up,—but into these subjects I must not now enter. The structure of the elementary parts from a malignant growth are represented in Plate III.

I have endeavoured thus to indicate very briefly some of the circumstances which probably determine the different characters of various morbid growths, including those tumors which have received the very inappropriate term of *benignant*, and the numerous intervening forms which pass by almost insensible gradations into those of a *malignant* character.

I might have advantageously devoted a longer time to this important subject, but I am compelled to dismiss it with these very few general and superficial remarks; I hope, however, you will bear in mind that the observations I offer are only intended as an explanation to the preparations which I show you; and, therefore, I think I may venture to make many cursory remarks which otherwise would hardly be justifiable.

Let us now examine one or two specimens of vegetable tissues, in order to ascertain if their structure and growth can be explained by the same general doctrine which I have shown will account for the appearances observed in the tissues of the higher animals, both in a state of health as well as in disease.

I commenced with the description of the characters of mildew, one of the simplest structures in the vegetable kingdom, and I have also shown you a preparation of another fungus. In these, as in the animal tissues, the *germinal matter* was coloured red with carmine, and the formed material remained perfectly colourless. It is, however, desirable to examine the tissues of one of the higher plants.

No. 30 is a portion of the young leaf of the common mignionette, showing the germinal matter coloured red with carmine.

No. 31 is a portion of the epidermis from the same plant. Numerous stomata are visible, and in the youngest elementary

parts, masses of germinal matter, stained with the carmine, may still be observed.

No. 32 is a small piece of a ro̊otlet of the mignionette. The elementary parts in this specimen are very beautifully coloured. No. 33 is a section of a common potatoe near the point at which a bud is being developed. In many of the elementary parts, the primordical utricle, and the nucleus (germinal matter), are well coloured, and in many cases, the central part of the germinal matter, is occupied by numerous small starch grains. I propose to call the matter deposited amongst the particles, or in the central part of the germinal matter, *secondary deposits*. The germinal matter will always be found between these and the so-called cell-wall. It is possible that these substances are precipitated in consequence of certain changes having occurred in the formed material in the interior, of a different nature to those which led to the formation of the envelope or cell-wall on the external part of the mass. In many cases the secondary deposits accumulate as long as any germinal matter remains in a living state. (Plate XV, figs. 2, 3.)

I have examined several vegetable structures, and they all exhibit the same general characters, and become coloured by carmine in the same manner.

We may then, I think, conclude that the elementary parts of all tissues, vegetable as well as animal, are composed of matter in two states, *germinal matter* and *formed material*, and that all growth takes place through the intervention of the germinal matter alone, which possesses the power of growing infinitely.

It appears that in certain cases both in animals and in vegetables the formed material or insoluble substances resulting from certain changes effected in it, may be deposited upon the external surface of the germinal matter, or it may accumulate amongst the particles of the germinal matter itself. The deposit in the latter case would take place first of all in the fluid which intervenes between the spherical particles of germinal matter, and this process having once commenced might proceed until a very considerable accumulation had taken place.

In many structures, the substance which is precipitated amongst the living particles in an insoluble form, is prevented from escaping through the outer layer of formed material or membranous capsule (cell-wall) within which the germinal matter (primordial utricle) and the substances which I have spoken of as secondary deposits (a part of the so-called cell contents) are found. The escape of these substances, which are

precipitated in an insoluble form, can never take place without the destruction of the whole mass, or the formation of an opening. If the products so formed were fluid, they would coalesce, and at length a mass of considerable size might be produced, and the actively growing or germinal matter would form a layer between the insoluble substance and the inner surface of the wall of the capsule, the position which the primordial utricle occupies in the vegetable cell, and the germinal matter (here called the nucleus), in the fat-vesicle. When these changes commence in the fat-cells, a little oil-globule is sometimes seen in the centre of a mass of germinal matter, and this might be mistaken for a nucleolus, but it is not coloured by carmine; and by carefully examining several masses in different stages of growth, its true nature can be made out. In other cases the fatty matter is deposited on one side of the germinal matter which gradually becomes pushed to the opposite part. In both cases the relation of the germinal matter to the investing membrane and the secondary deposits is precisely the same. (Plate XV, Figs. 1, 9.)

Sometimes particles in all parts of the germinal matter rapidly grow, pass through their stages of existence, and become resolved into a substance allied to that which is ordinarily applied to the thickening of the outer membrane. In this case the germinal matter will be found partly just within the membrane, and partly amongst the insoluble particles in the interior. In the large starch-holding cells of the potatoe, the living germinal matter is seen to be in contact with the inner surface of the capsule, while the starch-granules accumulate for the most part in the centre.

There is no difficulty in finding starch-granules, in every stage of formation; and careful examination will, I think, lead the observer to agree with me in the opinion, that the starchy material is deposited in successive layers, so that the inmost are the first, and the outermost, the last layers which have been formed, and the deposition has taken place more rapidly at one part than another, as shown by the different thickness of the layers at different parts of their circumference. (Plate XV, Fig. 1.)

The following very interesting point will also be observed by careful examination :—Insoluble matter has been deposited in successive layers on the inner surface of some of the large capsules, producing a laminated appearance exactly resembling that of a starch-granule, but spread out, as it were, over an extended surface. It is also important to observe that, at short intervals, there are openings in these transparent lamellæ

through which nutrient material passed into the interior of the capsule. These, are more correctly described as spaces or channels, which probably are closed on their outer surface by the thin membrane of the original cell-wall. Here the deposition of insoluble matter has never taken place, and through the spaces, currents of fluid pass to the interior, and continue as long as any living matter exists within in an active state. The mode of deposition of this insoluble matter can be very satisfactorily watched in these capsules (Plate XV, Figs. 2, 3.)* In many other vegetable starch-holding cells, the lamellæ and pores above described may be seen.

According to this view, the starch-granule is formed on the same principle as a calculus, and the *deposition* of the starchy matter from solution is purely physical, but its *formation* depends upon the peculiar properties of the particles of germinal matter, which select and combine substances in a special manner while passing through the various stages of their existence. At last their active powers cease, and their constituents become resolved into starch amongst other substances.†

One of the most interesting points which has been demonstrated during the last few years, in connection with the chemical changes occurring in animals, is the discovery that matters nearly allied to starch and cellulose were formed in them, as well as in plants. C. Schmidt, in the year 1845, proved the existence of a substance of the cellulose series in certain Ascidians; and Virchow, about the year 1854, made the very important discovery of an amyloid substance in the human subject. This was found in the form of roundish bodies in the deep layers of the membrane lining the cerebral ventricles, and that which lines the canal of the spinal cord. Since this time, amyloid matter has been demonstrated in many other situations. In the liver it is found in considerable quantity, and, as Dr. Pavy has shown, is a substance which is so easily and rapidly converted into sugar after death, that Bernard was led to conclude that sugar was actually formed in the liver in considerable quantity in health. In certain cases of disease, a

* The insoluble lamellæ are not starch, although they refract and polarise like this substance. These peculiar cells contain very little starch, and there can be no doubt that the changes which usually lead to the formation of starch have in these instances been modified so as to cause the altered matter to be deposited in a different position.

† The opinions generally held on the formation of the starch-granule are different to the conclusions in the text, *vide* a Paper by Mr. Busk, in Vol. I., New Series of the Trans. of the Microscopical Society, 1853, p. 58, and Professor Allman, "On the Probable Structure of the Starch-Granule." Quarterly Journal of Microscopical Science, Vol. II., p. 163.

substance containing amyloid matter accumulates to an enormous extent in the lobules of the liver, especially in their central part, giving rise to the amyloid or waxy degeneration (scrofulous liver, albuminous liver, spek-krankheit). This amyloid substance is one of several compounds, into which the formed material of the liver elementary part is resolved. In health it is carried away in a soluble form, and probably is soon converted into other compounds, which are at last resolved into carbonic acid. In diabetes, it is converted into sugar, and in certain scrofulous cases it accumulates in the liver, and in other tissues of the body, in an insoluble form. It is probable, however, that this amyloid material is not alone produced in the liver, for in disease it is found in connection with almost all the tissues, especially in the coats of the arteries.

Busk and Donders stated that the so-called amyloid bodies in the brain, and other parts of the nervous system, were actually composed of starch. Mr. Busk described their concentric laminæ, and stated that they behaved towards polarized light, and iodine, just as starch does. Of late, however, doubt has been thrown upon many of these statements, by the detection of starch almost everywhere, and it has been hinted, or actually asserted, that in many cases in which starch had been detected, it had an extraneous origin. Unquestionably there are cases in which this mistake has been made. Several have come under my own observation, but I feel sure that Busk and Donders were quite alive to the possibility of such an origin of the starch, and Virchow has especially cautioned observers against mistaking starch and cellulose accidentally present, for the substances actually formed in the living animal tissue.

I have always studied the fallacies likely to mislead in the course of microscopical inquiries with the greatest interest, and although I have always felt quite sure of the accuracy of the observations referred to above, it was not possible, without the most positive demonstrative evidence, to oppose the negative statements of those who were unable to confirm the reactions which others had obtained.

It is a pity that any one should record negative results in an examination like the present, especially as, where is well known, there is some difficulty in obtaining a uniform action from the test, unless he has devoted considerable time to all the little niceties which experience proves to be necessary in employing chemical tests in minute investigations.

Within the last few days, I have received a specimen of a cancerous liver, which weighed upwards of 13 lbs., containing nume-

rous bodies exactly resembling starch-granules. The evidence here against the *accidental presence* of starch is most positive.—1. From the testimony of Dr. Webb, of Wicksworth, from whom I received the specimen. 2. From the fact that these bodies were found in sections cut from the very centre of the mass I received. 3. That the starch bodies may be seen in the specimens actually embedded in the tissue, and they may be removed with fragments of the tissue of the liver adherent to them.

The specimens have been preserved, and I have every reason to believe will keep for years. As to the facts, therefore, in this one case, I can speak most confidently.

In No. 33*a*, a great number of these bodies, which I must call starch granules, for it would be difficult to distinguish many of them from potatoe starch, are present. You see them embedded in the substance of the tissue at different depths. The remains of the cell containing network and of the contained liver elementary parts (cells), can, in some situations, be distinctly made out; and in some specimens, the starch-granules were lying in immediate contact with the wasted cells, as if they were produced by changes occurring in the matter of which the elementary parts were once composed. Some of those which appear quite upon the surface cannot be moved by pressing the thin glass cover with a needle, proving that they are adherent to the tissue. I can show you the depressions in the tissue, which were occupied by others which have been removed. Some have very sharp angles, and most are discoidal in form. There is an indication of the existence of the laminæ; but in the faintness of the lines, and by the sharp angles seen in many, they differ from ordinary potatoe-starch.

In No. 33*b*, a section from the same liver, which has been treated with iodine and sulphuric acid, is shown. The globules are of a dark blue colour, and they are so highly coloured, that they appear quite black, when examined by transmitted light. Although the concentric lines are not so distinct as in starch, I believe that, as in the starch-granule, the starchy matter has been added in successive layers just as the calcareous matter is deposited round the spherical particles of brain sand, or calculous matter around smaller calculi, or around any foreign body which may serve as a nucleus for the deposition of calculous matter.

Under certain circumstances then, it appears that the formed material produced by germinal matter, both in vegetables and animals, may become resolved into starchy and other substances. The starchy matter may be deposited around

granules, layer after layer, until a mass of considerable size is produced ; or a material allied to starch, and formed from the same germinal matter as this substance may be deposited upon the inner surface of the investing membrane (cell-wall) of an elementary part in thin laminæ.

There is every reason to believe that in this case of cancer of the liver, the cell containing network of the lobules had been encroached upon by the cancerous growth, growing principally in the interlobular fissures. The excreting channels which carry off the bile would soon become occluded, and the distribution of blood to the substance of the lobule much diminished. Nevertheless, some of the masses of germinal matter of the original elementary parts still retained their vitality, as was proved by their being coloured by the carmine, and a certain amount of formed material under these disadvantageous circumstances was produced. We may assume that this, being placed under very adverse conditions, did not undergo precisely the same changes which occur in the normal state ; and amongst other substances resulting from the changes induced was this starchy matter, which was prevented from escaping, and was slowly deposited in the insoluble form, the amyloid masses gradually increasing in size by deposition on their exterior.

I propose now to consider briefly the bearing of the views I have brought forward upon the development of tissues, and their nutrition, growth, and decay. We shall next see how far they are applicable to the process of secretion ; and, lastly, I shall endeavour to draw some general conclusions as to the nature of the changes occurring in living matter, and try to ascertain what objects are fulfilled by the relation of the formed material to the germinal matter which seems to be so constant in the most dissimilar tissues.

In my second lecture, I endeavoured to show what was meant by certain degrees of vital activity. Life slowly shades into death, and although there is no difficulty in distinguishing a living structure from a dead one, there are in the normal state of living structures certain particles which possess some of the properties of germinal matter, although they are not capable of animating lifeless particles. These particles are in a transition state, and the matter of which they are composed is just about to become formed material. They are passing from a state of great activity to a less active condition. The oldest formed material is, as a general rule, gradually oxidised, and converted into simpler substances, which pass into the blood, and undergo numerous changes.

When the germinal matter of a tissue has almost entirely undergone conversion into formed *material,* and is, therefore, separated a considerable distance from the nutrient matter, the tissue possesses very little power of resistance, and in many cases is absorbed and replaced by new tissues.

In many cases, as I have before stated, the remains of the germinal matter enclosed in a thick layer of formed material, and separated a considerable distance from the nutrient matter, dies. The currents of fluid through the formed material, therefore, cease, and this substance is no longer permeated by fresh particles of fluid, by which process alone its integrity, and its functional activity, can be maintained. The tissue is dead, and will soon undergo decomposition, unless it is removed by living germinal matter, growing at its expense. If decomposition ensues, and the escape of the products is not provided for by other means, the tissues adjacent become softened and destroyed, and thus an outlet is made. As a general rule, however, before the remaining germinal matter dies, the formed material becomes altered, and the tissue is removed by the encroachment of living germinal matter, which appropriates it, and thus it may again be built up into tissue. There are few questions of greater interest than those which bear upon the removal and reconstruction of tissue in the adult. Until we have a history of these processes, it will be impossible for us to obtain a clear insight into the nature of morbid changes.

I have tried hard to ascertain if the dying tissue is encroached upon by the living elementary parts in the neighbourhood, or is, so to say, removed by the increase of the small amount of germinal matter still remaining encased in the thick layers of formed material. I believe that both processes occur. In developing bone I have seen appearances which make me think that an alteration and softening occur in the calcified formed material, within which a small portion of living germinal matter yet remains, and that these masses of germinal matter thus coming into contact with matter which they can appropriate, increase at the expense of this old formed material. After it has all undergone conversion into germinal matter or has been absorbed, the production of formed material again commences, so that the germinal matter may, at one time, produce formed material, and under other circumstances increase at the expense of the very tissue it has produced. It is most difficult to ascertain the precise manner in which these processes of building up and destruction are effected, for the investigation requires the tissues to be so prepared, that

the thinnest possible sections of textures which have not been altered by drying or boiling may be examined by the highest magnifying powers.   It is nevertheless quite certain that this alternate formation and removal actually occurs in bone.   The existence of the processes has been demonstrated by the beautiful researches of Tomes and De Morgan, published in the Phil. Trans., in 1853.   I shall have again to refer to these changes when considering the structure of bone.

There can be no doubt that a similar process takes place in the other tissues of the body, which are at a distance from cutaneous and mucous surfaces, and in the gland structures themselves, although the precise order in which the change occurs has not been so clearly demonstrated.   The epithelium of these organs is removed, and replaced as I have already described, but, besides this, the elementary organs of which the gland structure is composed are removed.   The oldest lobules on the surface of the liver, are undergoing absorption and removal, and a similar process is taking place beneath the capsule of the kidney.   The growth of the germinal matter, the formation of formed material, and the continual disinteg- ration of this, are continually taking place in all tissues, but the changes occur much more rapidly in some textures than in others.

The perpetual alterations which take place in the elemen- tary parts of the younger structures in course of development, and which lead only to the formation of imperfect tissues of temporary use, are instrumental in bringing about the condi- tions under which alone the higher and more perfect structures can be found.

In the *development* of all the higher tissues, structures which serve only a temporary purpose, precede the formation of organs which are to retain their characters for the remainder of life.   In many cases tissues having, nevertheless, performed very important offices for a time, cease to fulfil the requirements of the organism.   They waste, and are removed to make room for more perfect structures, or they may have no permanent representatives.   These temporary structures are not entirely removed by absorption, and a slight residue remains, which, in some cases, serves as a sort of matrix for the development of the new structure; or this residual tissue may form, as it were, lines by which the new structure undergoing development is conducted to distant parts.   When we examine fully developed tissues, we generally find a certain proportion of indeterminate structure, for the presence of which it is often very difficult to

account ; and its true nature and relations can only be under-
stood if the same texture in the same species of animal be
carefully examined, in precisely the same manner, at different
periods of life.

From what I have said of the power of infinite growth of
germinal matter, it is almost needless to state that in all tissues
there is provision for the development of a greater number of
elementary parts if they should be required.   Indeed, in the
intervals between adjacent but dissimilar textures, there are
elementary parts which are but imperfectly developed.   Up to
a certain period, these might have been converted into perfect
structures, but this being passed, they remain in a sort of
degraded condition, and are not functionally active.   They
produce a low form of tissue.   The germinal matter of the
elementary parts outside a bundle of striped or unstriped mus-
cular fibres, nerve fibres, and some other tissues, instead of
producing the peculiar formed material characteristic of these
tissues, which possesses special endowments, only give rise
to the production of a structure closely allied to fibrous tissue.
As will be supposed, a low form of fibrous tissue is found in
connection with all the more complicated tissues of the higher
animals.   We shall again refer to this subject, in connection
with the subject of areolar tissue.

When several elementary parts have been formed by division,
and thus the basis of the structure laid down, this process of divi-
sion ceases in that part which was first formed, and the production
of formed material commences.   Each mass of germinal matter
absorbs nutrient material, and gradually the formed material
increases, always being deposited between the portion last
formed and the germinal matter.   Thus each mass of germinal
matter is gradually separated farther and farther from its
neighbours, by the increase of the formed material.   In certain
cases the whole tissue is made to expand equally, in all direc-
tions, so that we may have a continually increasing solid figure,
growing equally, and preserving the same characters in every
part.

The multiplication of elementary parts still proceeds in
certain parts of the tissue, at least for a time.   In a leaf the
process soon stops, and the leaf, having attained a certain size,
does not increase, and at certain periods all the elementary
parts are cut off from the supply of nutrient matter and die.
The entire leaf, or stem with its leaves, drops off, or the entire
plant dies.

In animal tissues, however, the arrangement is such that
elementary parts, instead of dying and being cast off in quan-

tities at one time, are very gradually removed. New ones are continually growing up to take the place of those which have lived their life. The division and subdivision of germinal matter, and the multiplication of elementary parts, goes on throughout life, very rapidly in some tissues, very slowly in others ; but, even in very advanced age, it may occur in all. In the rapidly changing structures, especially in the glands, the constant activity of which organs is necessary to life, there must always be a certain number of elementary organs, and elementary parts, which, so to say, have only just commenced their existence. At this time derangements may take place in their growth, owing to improper pabulum and other circumstances. The effects of these alterations may not be made manifest till long after they have occurred,—in fact, not until the time comes when they should take the place of their predecessors, which in some cases does not occur until after the lapse of years. Such changes, however, affecting important glands, like the kidney and liver, and depending on causes long since forgotten, after progressing slowly, and almost imperceptibly are at last, fatal.

By making out the history of these alterations, and studying the conditions under which they occur, we may hope to be able to lay down such rules as may prevent or retard their progress ; or, by demonstrating that certain results must necessarily follow certain courses of action, we shall be justified in strongly insisting on the importance of rules of conduct being carried out, which may much reduce the probability of their occurrence.

I believe that in the development of tissue, the germs, which by their growth are instrumental in the production of the permanent texture, existed as new centres in that portion of the germinal matter of the pre-existing elementary parts which was not converted into tissue. It seems to me then, that in certain cases, a mass of germinal matter may in great part undergo conversion into formed material ; but in the small portion which remains, new centres of growth are produced. The germinal matter, of which these are composed, may not assume a state of activity, perhaps, for a long period of time. When the period for their development has arrived, the formed material around is softened. They grow at its expense, and at length the old tissue is removed and a new one produced, differing from it in most important characters. Successive series of new centres arise from those pre-existing, and these last were developed from prior ones.

In growth, the elementary parts multiply in number, and they may also increase in size.

In *nutrition*, without growth, an amount of inanimate matter becomes living germinal matter within a given time, exactly corresponding to the proportion of germinal matter which undergoes conversion into formed material, and this makes up exactly for the quantity of old formed material, which being no longer fit for work, is disintegrated, converted into soluble substances and removed.

In the higher animals, and in man, I believe the constituents of the food, proper for the nutrition of the tissues, become living germinal matter in the epithelium of the intestine, and in the chyle corpuscles. These living particles pass through their definite stages of existence. The chyle corpuscles give rise to the formation of red-blood corpuscles, the formed material, of which becomes resolved into substances differing in composition and properties from the food, as albumen and other substances which are dissolved in the fluid part of the blood. These constituents of the serum of the blood are not living,— they have been so, and may again become so when taken up by the germinal matter of the different tissues.

I have already adverted to the position in which lymphatic vessels are found. Within them are masses of germinal matter which, doubtless, would appropriate any redundancy of nutrient matter which the neighbouring tissues could not take up. In the form of lymph corpuscles this is returned to the blood, and these bodies at length assume the form of white-blood corpuscles, as already described. It is not improbable that the hæmato-crystallin of the red-blood corpuscle is by the action of oxygen gradually resolved into two sets of compounds, the one which takes part in nourishing the tissues (albumen and other substances), the other which is to be eliminated (urea, extractives, carbonic acid, and other substances).

If all these processes go on actively, the entire organism is in a healthy condition, but, if any be imperfectly performed, the action of the tissues is affected, and disease may result.

In *secretion*, the formed material is, I believe, gradually altered, and is at last resolved into the substances characteristic of the secretion. This process is much more rapidly effected in some secreting organs than in others. The end of the life of the particles of germinal matter of the elementary parts of the liver, is the production of formed material, which is at length resolved into bile,—a substance easily converted into sugar,—and other compounds. As urea exists in the healthy blood, it may be that it is only separated and taken up by the elementary parts in solution in water. It is most likely, however, that the extractive matters, and some other constituents

of the urine, and perhaps part of the urea, result from changes taking place in the formed material of the renal epithelium.

The peculiarity of each secretion depends to some extent upon the state of the blood, but mainly upon the peculiar powers of the germinal matter, and these properties often differ in the most remarkable degree in animals closely allied to each other. The milk, for instance, of mammalian animals possesses certain characters which at once distinguish it from every other secretion. It contains, as is well known, a cheesy substance, a fatty and a saccharine substance, and saline matters, but these differ in their relative proportions and in some important qualities, in the milk of different animals. These differences depend upon the properties of the particles of germinal matter of the lacteal elementary parts which at length become resolved into the constituents of milk. As we have (so to say) certain generic and specific differences in the tissues of various animals, so also corresponding differences exist as to the chemical components of their bodies. We have in all, bile and saliva and gastric juice, and urine, &c.; and in the blood we have albumen and fibrin and hæmatoglobulin. But the bile, saliva, and other secretions of different animals, possess well-marked differences, and of albumen and hæmatoglobulin there are certainly many different kinds capable of being distinguished from each other by chemical and other tests. It is probable that we can, as yet, form but a very imperfect idea of the chemical changes which take place in, and the number of compounds which intervene between, a particle of food and the particle of tissue formed from it. These chemical substances may vary very slightly in composition and other characters, in animals nearly allied to each other, so that many varieties may be produced, all differing slightly from each other, but having certain characters in common which justify us in calling them all by one name.

The substances resulting from the disintegration of these compounds are in many cases exactly alike. Urea and uric acid are formed by animals whose albumen and hœmatoglobulin are very different. We find constantly that the most complex substances, when acted on by oxidising agents, give rise to the production of precisely the same compound. The elements of the substances are probably grouped together to form these complex compounds after the conversion of the pabulum into germinal matter, while the particles of germinal matter are passing through the various stages of their existence. At present we cannot form any idea of the nature of the chemical relations of the living matter. As the particles pass through the stages of formed material, disintegrated formed material, and

products resulting from the action of oxygen on these, they become more and more simple in constitution, until, perhaps at last, they are resolved into carbonic acid, ammonia, and other comparatively simple substances.

The consideration of the different results of the growth of the germinal matter is interesting in another point of view, which I may just hastily glance at. Although in different animals of the same species, the powers of the germinal matter, the properties of the tissues formed from it, and the chemical compounds produced in the organism, exhibit certain differences, these differences shade into insignificance when compared with the differences observed with respect to the same points in animals of different species. It seems probable that in certain cases in which it is difficult to determine the question of distinct species or mere variety, a careful study of the physiology of the creature would much assist in settling the question. Anything approaching a complete history of the life of a creature would, in all probability, enable us to determine at once the question of species or variety.

Secretion then differs from the formation of tissue only in this, that while the end of the existence of the particle of germinal matter of a secreting elementary part is the production of formed material, which is soon resolved into the constituents of the secretion, that of the tissue forming particle, is the production of formed material, which shall last for a much longer time, and in many tissues perform, while it lasts, very important offices. But even this tissue is gradually resolved into simpler substances, and, moreover, gives place to new tissue which is being produced by the formed material.

Let me contrast with each other, in few words, the processes of development, growth, nutrition, and secretion. In development one series of elementary parts is replaced by another, having different endowments, and the last has descended from the first. In growth, an increased number of elementary parts is produced. In nutrition, the decay and removal of old elementary parts is exactly compensated for by the growth of new ones. The old elementary parts are removed entire, in some tissues (mucous membranes, cuticle, &c.), while in others they are appropriated by living germinal matter, and absorbed (nerves, muscles, &c.). In secretion the formed material of the elementary part is soon resolved into the substances of which the secretion is composed.

I have endeavoured to show, with regard to the elementary parts, ordinarily termed cells, that a cell wall is not a necessary

structure, and that *the action of the cell,* which has long been a subject of very warm discussion, consists simply in this, that the living particles of the germinal matter pass through certain definite stages of existence. During the active period of the existence of these living particles, the most important chemical changes are occurring, and every particle is moving in a determinate direction *from* a centre. At last it becomes resolved into *formed material,* the composition and properties of which are very different, and these differences depend upon the different powers of the germinal matter which produced it. The conversion of germinal matter into formed material goes on, and the germinal matter of many tissues lives for a short time after the death of an animal; but sudden death by lightning, or violent shock, &c., may, there is reason to believe, at once arrest the conversion of germinal matter into formed material.

Let us consider very briefly what very important objects, especially in the tissues of the higher animals, are fulfilled by these wonderful but most simple conditions. The movement outwards of the particles, causes currents in the opposite direction, and thus the nutrient material is brought into very close relation with, in fact within the sphere of action of, the living matter. The formed material in the elementary parts of the tissues being as it were external to the germinal matter, in which all these changes go on, is continually bathed with fresh particles of fluid, and this fluid is maintained in a state of constant motion. Were stagnation to occur, changes would take place in the fluid corresponding to those which may be induced if it were kept at the temperature of 100 degrees for a short time out of the body. Decomposition would result, and in consequence, compounds would be set free, which would destroy the vitality of the germinal matter in the neighbourhood, and the death of this portion of the tissue would result. The stagnation of the fluids which bathe every part of every tissue will explain most satisfactorily many of the morbid changes which occur, especially in those tissues in which the activity of the changes in the normal state is not great, as in the fibrous tissues generally, cartilage, the thick walls of arteries, &c. In such textures various substances which ought to be removed in a fluid state become decomposed, and resolved into insoluble substances, some of which may be again taken up, while others, once precipitated, can never be removed except by the destruction of the tissue; but here, I find myself led into making a long pathological digression, which I must now abruptly break off, as such an extensive subject as this must be considered separately.

Neither is it possible, in a short course of lectures like the present, nor at this time would it be right to discuss the bearing of the views I have advocated upon the opinions generally entertained of the nature of disease. I may, however, be permitted again to allude to the very broad and important differences observed in the same texture, under varying conditions, with regard to the rapidity of multiplication of the masses of germinal matter, the proportion of formed material produced, the character of the formed material, its disintegration and the different products resulting therefrom in various cases. In scrofulous conditions there seems to be a tendency to the formation of a large quantity of germinal matter with the production of very little formed material,—and this affecting not one but many tissues of the body. The accumulation of formed material to an unusual extent, in certain important tissues, would seriously impair their function ; while, on the other hand, an unusually rapid disintegration of the formed material as occurs in fevers would be productive of a different order of morbid changes.

Surely it almost amounts to a certainty that if we could study the different morbid processes in their minute detail, and ascertain their exact nature, and the precise order in which they were set up, we should be able to exert a much greater influence over them than we can at present.

RESULTS OF THE CHEMICAL AND MICROSCOPICAL EXAMINATION OF VARIOUS SPECIMENS.

ON THE DIFFERENT MICROSCOPICAL CHARACTERS OF THE SECRETIONS FROM INFECTING AND NON-INFECTING SYPHILITIC SORES.

By Henry Lee,

Surgeon to King's College Hospital; Surgeon to the Lock Hospital and Asylums.

DURING the years 1855 and 1856 a register was kept at the Lock Hospital of the cases which came under my care, and the characters of the secretions from different kind of syphilitic sores were noted. During the same years a similar record was, for some time, kept at King's College Hospital; but the very large number of patients, and the irregularity of their attendance, prevented the plan being there so fully carried out.

The object of the investigation was to ascertain whether the secretions from the surface of syphilitic sores afforded any characters by which the nature of those sores might be recognised, and especially whether those secretions would furnish a test of the liability of the sores to be propagated by contagion to another part of the same patient's body on the one hand, or of their power of infecting the patients' constitutions on the other.

It became very soon apparent that sores which were the most contagious (*i. e.*, liable to be communicated by contact, or by artificial inoculation to another part of the same patient's body) were the least liable to be infectious (*i. e.*, were the least liable to infect a patient's constitution); and the converse of this was proved to be true, namely, that those sores which were likely to be followed by constitutional infection or secondary symptoms, were not, as a rule, contagious as far as the patients themselves were concerned. It was found that the local con-

tagious disease could be inoculated upon the same patient almost an indefinite number of times; but that the infecting disease, when it had once developed its morbid process, could not again, as a rule, be reproduced either by contact or by artificial inoculation upon the same patient. Upon a patient who had not previously had syphilis it would doubtless be inoculated readily enough; but from the nature of the case any experiments of this kind were not instituted.

Now, in examining the secretions under the microscope of these two classes of cases, those from the contagious local sores were, as a rule, very much of the same nature. They always presented well-formed pus globules, so long as their characteristic contagious nature remained; and if a little acetic acid was added to the secretion before it was examined the distinct nuclei of the pus globules were rendered visible. These nuclei were generally of the same shape and size; and one, two, or three of them might be seen in the space occupied by each pus globule. Professor Beale has been kind enough to draw these appearances for me, and they are represented in the accompanying woodcut.

Fig. 11.
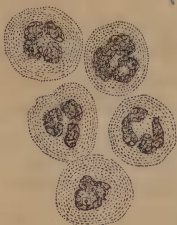
Microscopic appearance of secretion of local suppurating syphilitic sore treated with acetic acid, × 700.

The secretions from the second class of syphilitic sores, namely, those which were not again inoculable upon the same patient, but which were, as a rule, followed by secondary or constitutional symptoms varied very much more than those of the first class above described. They consisted generally of epithelial débris floating in a transparent fluid; or of globules of various shapes and sizes often matted together. Upon the addition of acetic acid nuclei were sometimes seen to occupy the interior of the globules; but these were again of different sizes and shapes, and of varying degrees of opacity. When care was taken to obtain nothing but the natural secretion from these sores the well-formed pus globules (with their characteristic nuclei upon the addition of acetic acid) were absent. In some cases it was found difficult to obtain the secretion from the sore unmixed with that of the neighbouring inflamed mucous membrane; in others, the nature of the secretion had been altered by the application of caustics; in others again, the part had become irritated by the prolonged detention of diseased secretions upon its surface, or by mechanical means. In all these instances it was found necessary to distinguish between the natural secretion of the part and that which was produced by the accidental irritation. In order to effect this

it was generally found sufficient to apply water dressing to the sores for two or three days. The accidental irritation had then usually subsided, and the natural secretion would be obtained unmixed with other fluids. When thus examined, it was found that the secretion of the sores which could not be inoculated again upon the patients who had them, but which, as a rule, produced secondary symptoms in those patients, did not contain well-formed pus globules ; and that when globules were present in the secretions, they did not, upon the addition of acetic acid, yield the characteristic nuclei of pus. A clear diagnostic sign was then here established between those sores which were in their nature likely to infect a patient's constitution, and those which were not. The first were found to be suppurating local affections, requiring only local treatment ; the latter were found to depend upon the adhesive form of inflammation, and to require mercurial and other constitutional treatment.

Fig. 12 represents the secretion from an infecting sore treated with acetic acid, and seen under the microscope with a power of 700 diameters.

The mode of distinguishing the different kinds of primary syphilitic sores now described, affords in practice most important and valuable information. By this means a chancre, which, if left to itself, would infect the patient's constitution, may be distinguished from one which will not, even in cases where the ordinary mode of diagnosis fails. Thus, out of a hundred cases that were noted and registered (during the period above mentioned) as presenting, upon microscopic examination of the secretion, the characters of suppurating sores, in two only, as far as I could ascertain, did any constitutional symptoms follow the local affection ; and even in these two cases it was satisfactorily made out on further inquiry, that the patients had exposed themselves to more than one source of disease. The contagious suppurating sore in these two cases may, therefore, in reality, have been super-added to, and have masked the non-suppurating infecting sore. On the other hand, during nearly the same period, ninety-five cases were recorded in which the secretion was not purulent, according to the test above mentioned, and these presented the ordinary characters of the primary indurated chancre.

Many of these cases individually were lost sight of after they left the hospital, but during the same period seventy-three

Fig. 12.
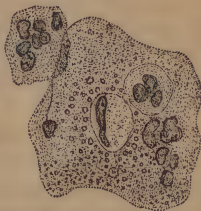
Microscopic appearance of cells of altered epithelium of an infecting sore, × 700.

cases were noted as having presented constitutional symptoms, where there was evidence of the primary disease having been accompanied by the adhesive, and not by the suppurative inflammation.

LARGE AMOUNT OF CHLORIDES, WITH DEPOSITS OF CYSTINE, URATES AND OXALATE OF LIME, IN THE URINE OF A CASE OF LONG-CONTINUED SWEATING.

By George D. Gibb, M.D., M.R.C.S.

ON the 15th March I had the opportunity of examining a curious case of profuse sweating, through the kindness of my friend, Mr. McWhinnie, of New Bridge-street, Blackfriars.

The patient was a young man, about 25 years of age, a butler, in the service of a distinguished General. About four years ago, when at the lakes of Windemere with the family, he was suddenly attacked with the most profuse sweating. This has constantly remained ever since, no part of his body is exempt from it, although it occurs with greater profusion in some parts than in others. The face and forehead are frequently bathed with big drops of perspiration, and the hands are, at times, quite red, and look as if parboiled. He has to change his linen two or three times a-day, and his stockings oftener. The odour at times from his body is very strong. About a year ago he suffered in addition from sychosis mentagra, of which he was cured by Mr. McWhinnie. His general health has otherwise remained good, but he is subject to occasional relaxation of the bowels, showing that the mucous membrane of the alimentary canal is equally affected with the skin. Any slight exertion, or any little shock, causes profuse perspiration.

A sample of urine passed on the morning of the 16th I submitted to very careful examination, with the following results.

It was of a full amber colour, and clear; feebly acid; sp. gr. 1028. In a few hours it turned opaque and muddy, from the deposition of a considerable quantity of pink urate of soda, which readily dissolved on applying heat. The usual

salts of urine were discovered, and the present sample contained a *very large amount of chlorides*, as shown by adding a few drops of a solution of nitrate of silver, when a dense white precipitate was formed, which pervaded the entire fluid in the test tube, resembling boiled urine loaded with albumen.

Two drachms of the urine were evaporated to one half, and some nitric acid added, when floating crystals of nitrate of urea were formed in a few minutes, the urine remaining fluid. A similar quantity of urine was evaporated to one fourth, and the addition of nitric acid rapidly produced a solid cake of nitrate of urea, with effervescence. The urinous odour was perceptible during the evaporation of the urine. No albumen, nor sugar, nor hippuric acid could be detected. In testing for the last, the urine was first deprived of its large amount of chlorides.

Some drops of the urine were evaporated spontaneously on a glass slide and examined under the microscope. Numerous dumb-bell crystals of the oxalate of lime were observed, and a tolerable number of flat crystals presenting the characters of cystine.

Upon examining the urine, after standing some hours, the subsided deposit was found to consist chiefly of the urate of soda.

The patient is naturally very anxious about his complaint, which is very distressing to him, and this anxiety may, to some extent account for the presence of oxalate of lime and cystine, but it will not explain the large amount of chlorides.

I learned that he was a moderate liver, and not given to excesses of any kind.

His general condition appears to me to be the opposite to that observed in diabetes, for here is the skin doing a large amount of work, which is managed by the kidneys in the former malady. I will venture the opinion that in the present instance there is a considerable diminution of the hepatine or amyloid producing principle in the system, which shows itself in the profuse diaphoresis; whereas, in diabetes, that principle is in excess, the skin is harsh and dry, and the kidneys are acting like water mills.

DISEASED PANCREAS.   FROM A CASE OF SICK HEADACHE.
SUDDEN ATTACK OF VOMITING, COLLAPSE, AND DEATH.

By Charles Hooper,

Surgeon to the Bucks General Infirmary.

I ONLY saw this case about an hour before death, but have known the man for several years. Although he expressed himself as being in excellent health I refused on several occasions to admit him into a benefit club, because I thought, from a quick feeble pulse and bloated appearance that all was not right; but never having been called upon to prescribe for him, I did not carry my examinations any further. He would not allow that he suffered any inconvenience whatever.

Mr. R——., æt. 44, grocer and lace dealer, always lived at Weeden (near Aylesbury), a healthy village on the top of a hill: of active temperate habits: fat, florid complexion, but bloated appearance; has suffered for some years from what he considered bilious attacks, two or three times in a fortnight. Other attacks consisted of vomiting sometimes of clear water, at others of yellowish and green-coloured fluids, occasionally of food; they generally came on at night, soon after going to bed. He would feel uneasiness, not amounting to pain, which went off after he had been sick. Had to make water several times in the night. Urine sometimes was thick, and stained the vessel red. Appetite not very good, except at night, when he would generally eat a hearty supper.

May 15th, 1860.—Has continued his occupation up to the present time, considering himself quite well. At 1 p.m. he was seized with severe pain below the left breast (as he described), and sickness, bowels confined, considerable tympanitis. States he had eaten very heartily of beef last night, and thinks this is the cause of his attack. He fears obstruction of the bowels, and was ordered a dose of calomel and saline purge; pulse weak, not more than 80; no evidence of pleurisy. Pain continued with constant vomiting all day tympanitis increasing.

May 16th.—Pulse still small and feeble; seems much exhausted by pain; vomited matter black; bowels well relieved; ordered effervescing ammonia mixture, calomel and opium; turpentine stupes over abdomen; pain is now general over the whole surface abdomen.

17th.—Pain relieved by stupes, vomiting continues, bowels

relieved during night, surface cold, no pulse, in a state of collapse, perfectly sensible, died about noon. Autopsy about twenty-four hours after death. Abdomen only examined, about one-and-a-half-inch of fat over the abdominal parietes ; muscles small, apparently wasted ; great deal of fat in the great omentum and mesenteric folds ; small and large intestines much distended with flatus, the former of rather a pink appearance ; no lymph or fluid effused ; stomach not much distended, but there was the same appearance of congestion of the mucous membrane towards pyloric orifices ; some difficulty was experienced in removing the stomach and duodenum on account of the enlarged and friable pancreas, and the immense quantity of fat in folds of the peritoneum. " I have sent you the pancreas in two pieces, and also a part of the liver, which was large and fatty ; these I will leave to you to describe. The kidneys were flabby, rather small, imbedded in immense quantities of fat, fibrous capsule easily shelling, colour pale, not friable ; cortical and tubular portions appearing on section more smooth, their characteristic marks less visible, than usual. I am indebted to Mr. Spencer, of Whitchurch, for information as to the present attack, and the previous history I have gathered from his wife."

Examination of the pancreas.—The tissue of the pancreas was hard, but brittle. Throughout its substance were several dark red patches—apparently small extravasations of blood. The dark colouring matter was found to be in the follicles of the gland. In many instances the epithelium was tinged of a dark and brown colour. In other follicles very small dark black masses, apparently resulting from changes in small clots of blood, which had been for some time extravasated, were observed.

Several of the follicles were completely disorganised, and their place was occupied by large globules of fatty matter, from which much margarine crystallised out. There were very many small granular cells in the intervals between adjacent follicles. I think that in this case there had probably existed a congested state of the pancreas for a considerable time, and that successive attacks of capillary hæmorrhage had taken place ; the blood being extravasated within the follicles of the gland, which not unfrequently happens in the case of the gastric glands of the stomach, Lieberkuhn's follicles, the uriniferous tubes, and other organs. The blood had afterwards undergone change, partly from the action of the secretion of the gland upon it, but principally from its remaining for some time in contact with living tissue. A degenerative process had undoubtedly been going on in the gland itself.

The liver was an example of ordinary fatty liver, in which the fat had accumulated at the circumference of the lobules. It is a very interesting question how far the disease of the pancreas may have been connected with the sick headaches in this case. The immediate cause of the fatal attack is somewhat obscure. [L. S. B.]

PORTION OF THE KIDNEY PASSED FROM THE URETHRA.

A short time since Mr. Newham, of Bury St. Edmunds, sent me a small piece of soft pulpy matter, which had been passed with the urine by a boy, aged 11. The case was under the care of Mr. H. Taylor, of Ixworth, to whom I am indebted for the following short account of the case :—

Case.—Taber Haunton, æt. 11 (one of a family of nine, father stammers, and the subject of chronic eczema since childhood). Had an attack of scarlatina in the autumn of last year.

I first saw him November 22nd last; had then been ill some time; there was great prostration and emaciation; pain in abdomen, more on the left side, to be traced in the course of the ureter; urine scanty, rather frequently voided and loaded with pus; there had been no trace of blood that I could learn. The pain in the abdomen soon ceased; and, until about thirty hours previous to his death, he suffered scarcely at all; at this time violent enteric pain occurred, which was, however, soon relieved by a few full doses of opium. He died February 8th. During the progress of the case the amount of pus in the urine varied considerably; at times it was scarcely to be traced, at others the quantity was very great. *On one occasion the urethra became obstructed, and after some effort a mass of considerable size, weighing between twenty and thirty grains, was passed.* I directed strict watch to be kept, but it never occurred again. He was throughout able to take but little nourishment, and appeared to sink gradually from exhaustion.

Post-mortem appearances.—(The examination was very limited owing to the constant presence of the father, who, however, allowed the kidneys to be taken away for further examination.) On opening abdomen the parietal peritoneum was found unusually tough, and the whole colon showed signs of recent inflammation; around each kidney were adhesions evidently of old standing, and at the point of union, between the ascending colon and right kidney, the bowel was perforated and pus flowing freely into it (this, no doubt, accounted for the pain shortly preceding death); the pelvis of both kidneys enlarged

and dilated to the extent of a small bladder, and the ureters enormously dilated. The liver was healthy, but rather large; and as far as the examination went the other viscera of the abdomen appeared healthy.

Examination of the specimen.—The piece of kidney was ragged, soft, and pulpy; of a grayish colour. It was partly decomposed. The Malpighian bodies were distinctly seen; and several of the tubes, with epithelium within them, were remarkably distinct and well defined. There could not be the smallest doubt as to the nature of the specimen. After the boy died the kidney was forwarded for examination. It was much sacculated. The infundibula and calyces very much dilated, and the whole surface of the mucous membrane covered with a quantity of pus. The renal tissue was much softened, and the suppurative process was extending in various directions. Ragged portions of the kidney, apparently about to separate as small sloughs, were seen here and there. The state of the organ fully accounted for the presence of the portion passed by the urethra, and was exactly what would have been expected from an examination of the specimen passed during life.   [L. S. B.]

VERY MINUTE SARCINÆ.

In a specimen of vomit, sent to me by Mr. Bowman, which had been rejected by a man who had been for some time subject to obstinate vomiting, I found some exceedingly minute sarcinæ. The vomit was not remarkable, and did not present the yeastlike appearance so common in cases in which the ordinary sarcinæ are present.

Fig. 13.

It contained small quantities of food, numerous altered starch granules, &c. There were no ordinary sarcinæ, and the peculiar form delineated in Fig. 13 were present in great number. They were smaller than any specimens I had met with in the urine or elsewhere; and this was the only case in which I have seen this peculiar form. [L. S. B.]
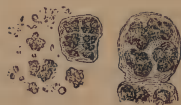
Very minute sarcinæ magnified 215, 700, and 1,700 diameters.

EXAMINATION OF THE URINE AND KIDNEY OF A CASE OF ACUTE SUPPURATIVE NEPHRITIS.

THE following notes were sent to me by Mr. Newham, of Bury St. Edmunds, and the case occurred in the practice of Mr. Image.

J. C., aged 33, a fine fresh-coloured healthy looking man, admitted into the Suffolk General Hospital with strangulated hernia, Jan. 12. On the 13th he was operated on by Mr. Image. Very great difficulty was experienced in returning the gut within the abdomen, it was consequently much handled. Opium freely administered. On the 17th slight erysipelas appeared about the wound, which began to discharge freely. The patient was feverish, and the breathing hurried upon the slightest movement. This latter symptom he states he has experienced in a trifling degree for the last two or three months, but never to the extent of preventing in any degree his usual occupation of labourer. On the 20th the note is " Erysipelas has subsided, breathing a little shorter, no cough. Bowels relieved without the aid of aperients. Urine has exhibited nothing abnormal, is passed freely, and in fair quantity; he still looks fresh, and appears to be doing well. Appetite good." On the 21st he passed urine with a considerable admixture of blood corpuscles. It deposits many blood casts, urates, and uric acid. No pain anywhere, feels a little weak, pulse natural. Respiration still hurried on exertion. Sounds of lung and heart present nothing unusual. The urine had the same character on the 27th; in quantity it was much too little. No particular difference in other symptoms.

Feb. 4th.—Urine now contains only a few blood casts; no urates or uric acid deposit, but is small in quantity, and highly charged with large, long, transparent tube casts, and much detached epithelium. The general surface to day, for the first time, looks rather pale, and there is a slight general anasarca. No other difference.

Feb. 6th.—The urine gradually diminishing in quantity. The surface is very pale, not sallow or waxy-looking. The breathing more difficult; a slight cough and frothy bloody expectoration; lungs œdematous.

Feb. 9th.—He died. Urine for last three days all but suppressed. Anasarca at last, but not at all excessive. He never complained of pain anywhere. The appetite was scarcely interrupted throughout his illness; no disturbance of sensory

or motor powers; never had vomiting except *before* the operation.

Post mortem.—The wound was nearly healed; the cœcum, portion of colon and ileum which were extended presented a leaden appearance of firm consistence, and were adherent to the parietal peritoneum around the neigbourhood of the wound. Everything appeared to be wonderfully reparative; not a trace of purulent deposit about the intestines, which with the above exception looked perfectly healthy; the liver and spleen were in every respect natural; no fluid in peritoneal cavity.   *One kidney weighed* 13, *the other* 15 *ounces*.   The urine sent to Dr. Beale for examination was passed about 3 days before death.

Examination of the urine and kidney.—The urine became solid on the application of heat.   The deposit consisted of very numerous casts, containing cells like pus, with numerous free cells exhibiting the same characters, and blood corpuscles. From the appearance of the cells in the centre of the casts, one could not but conclude that they had undergone division and subdivision while entangled in the coagulable material.   The appearance is represented in Plate XIV, figs. 1, 2, and 4.   Some of the free cells found in the urine with some blood corpuscles are represented in fig 3.

Several bodies like that represented in fig. 3e were found in the urine.   The oval nucleus in the centre was coloured with carmine, proving that it was composed of living germinal matter, and the two processes projecting from it had a fibrous appearance, and were not colored by the carmine.

The capillaries of the kidney were two or three times their diameter in the normal state; they admitted two rows of large and apparently spherical cells like white blood-corpuscles. These were all coloured red by the carmine (Fig. 5).

The capillaries of the Malpighian body were also crowded with similar structures (Fig. 6), and several which however appeared somewhat flattened, existed between the inner wall of the capsule of the Malpighian bodies and the capillary tuft.

Remarks.—The greatly increased size of the kidneys in this case appeared to be due to the enormous increase of the granular cells like white blood corpuscles.   These having increased in number became impacted in the tube, and must have greatly interfered with the circulation through the kidney.   The congestion was to some extent relieved by the draining off of a large quantity of albumen and the material of which the casts were composed.   With these soluble substances which transuded through the vessels, small portions and nuclei of the

spherical bodies passed into the uriniferous tubes, and then underwent increase of size, and divided and subdivided.

In another place (page 336) I have shown that white blood-corpuscles are masses of living, active, germinal matter, and always increase in number when placed under favourable conditions, of which conditions, abundance of the proper pabulum and rest are essential. In the present case life could not continue with such a condition of the kidneys, but had it been possible to keep the patient alive longer, the processes above described would undoubtedly have continued, and the whole kidney would have suppurated or passed into a state of mortification.

Some of the masses of germinal matter between the capillaries and the wall of the Malpighian capsule had undergone a further change, but it is not quite certain if the structures under consideration had descended from the tissues of the part, or had been developed from the white blood-corpuscles. From the fact that particles were present in every stage from the undoubted white blood-corpuscle to the spindle-shaped masses (Figs. 3e, 7, Plate XIV). I incline to the latter view of their origin.

I believe that this was an example of the tendency of the white blood-corpuscles, or bodies descended from them, to produce, under certain conditions, formed material in the form of fibrous tissue, while under other circumstances corpuscles which would have at length given rise to true pus corpuscles were formed.

There can be no doubt that the nature of the bodies in the capillaries, in the Malpighian bodies, in the casts, and in the urine, was the same. In many of these cases of acute nephritis the whole of the deposit in the urine is found to consist of cells like pus corpuscles, which are in all probability derived from the epithelium of the uriniferous tubes. Sometimes it is impossible to distinguish these from pus. In the present instance, however, it was not possible to recognize the epithelium with any degree of certainty. Blood-corpuscles were present in considerable number, proving that rupture of capillaries had occurred, and as the cells in question were found for the most part in the centre of the casts, it is probable that they were extravasated from the vessels, and after being set free increased in number. At the same time, it would be quite impossible to distinguish a pus corpuscle which had descended from the germinal matter of an epithelial cell from one which had resulted from successive changes, occurring in the masses descended from white blood-corpuscles.   L.S.B.

PROCESSES AND INSTRUMENTS OF PRACTI-CAL VALUE IN CARRYING OUT SCIENTIFIC ENQUIRIES BEARING UPON MEDICINE.

ON A CLINICAL MICROSCOPE.

By Lionel S. Beale, M.B., F.R.S.

PLATE XVI.

FOR some time past, I have been in the habit of using the instrument figured in Plate XVI, and, as it fulfils the purposes for which it was intended very satisfactorily, I am desirous of recommending it generally for class purposes. A short description has been already given in the "Transactions of the Microscopical Society," but since this appeared, it has been further improved, and a stand has been made for it with a lamp adapted, so that the whole may be readily passed round a class without the possibility of the specimen shown being deranged.

THE MICROSCOPE.

Like some other instruments which have from time to time been proposed, this microscope is composed of draw-tubes like a telescope; but the arrangement of the stage, and the plan adopted for moving the slide, when different parts of the object are submitted to examination, differ entirely, as far as I am aware, from those hitherto adopted. The instrument consists of three tubes, *a, b, c* (Fig. 1, Plate XVI); *a* carries the eye-piece, is four and a-half inches long, and slides in *b*, which is of the same length, but only slides up to its centre in the outer tube *c*. Tube *b* carries the object-glass. There is a bolt on tube *c*, which can be fixed by aid of a rack and tooth, at any height, according to the focal length of the object-glass. This arrangement prevents the risk of the object-glass being forced through the preparation while being focussed. The same

x 2

object is fulfilled by a screw clamp round the upper part of the
tube *c*, as shown in Fig. 2. At the lower part of the body is
a screw clamp for fixing the preparation in any particular posi-
tion, and an aperture for throwing the light on opaque objects.
The preparation is kept in contact with the flat surface below
by a spring, which allows the requisite movements to be made
with the hand. (Fig. 7.)

That part of the object which it is desired to examine can
easily be placed opposite the object-glass, if the instrument is
inverted. Next, the focus is obtained by a screwing movement
of the tube *b*; and if it be desired to examine any other parts
of the object, this is easily effected by moving the slide with
one hand, while the instrument is firmly grasped with the other.
Delicate focussing is effected by drawing the tube *a* up and
down. By this movement the distance between the eye-piece
and object-glass is altered.

Any object-glass may be used with this instrument. I
have adapted various powers, from a *three-inch*, magnifying
fifteen diameters, to a *twelfth*, magnifying *seven hundred*
diameters, and I feel sure that even higher powers may be
used.

In the examination of transparent objects, ordinary day-
light, or the direct light of a lamp may be used; or, if more
convenient, the light may be reflected from a sheet of white
paper, or from a small mirror inclined at the proper angle, and
placed on the table.

In examining objects by reflected light, sufficient illlumina-
tion is obtained from an ordinary wax candle placed at a short
distance from the aperture, just above the object. But the
most beautiful effects result from the use of the Lieberkuhn
with direct light.

The slide, as has been stated, is kept in contact with the
lower part of the instrument, which I have called the stage, by
a spring which is therefore made to press on the *back of the
slide*. On the other side of the stage a little screw and clamp
are placed so that the specimen may be fixed in any position
that may be desired. (Fig. 4).

In using this microscope the slide with the object to be
examined is placed upon the stage, the thin glass being
upwards towards the object-glass, while the spring is made to
press upon the *under* surface of the slide. The little screw is
removed. The slide may now be moved in every position, and
any particular object to be examined can readily be placed
exactly under the object-glass. Tube *a* is withdrawn about
two-thirds of its length. The tube *c* being firmly held with

the left hand, *b* is grasped with the right, and with a screwing motion the object-glass is brought to its proper focus. The specimen having been fixed with the little clamp, and the bolt arranged at the right height or the tube fixed in its position by screwing down the ring fitted on tube *c*, the instrument may be passed round a class. This microscope seems to be well suited to field-work and botanical purposes. It is not heavy, and, including the powers and an animalcule cage, will easily pack into a tube or case six and a-half inches long and two inches in diameter. I constantly use it in clinical teaching. Urinary deposits, specimens of sputum, &c., may be examined by the patient's bedside, and their characters demonstrated to the class.

The instrument can be seen at Mr. Matthews', Portugal Street, Lincoln's Inn.

THE STAND.

The arrangement of the stand will be at once understood by reference to Fig. 10, page 215. The structure of the lamp is represented in Fig. 8, Plate XVI. It is an ordinary oil lamp with a diaphragm just level with the wick in order to cause a powerful current of air around the flame. By this means all flickering is prevented, and the instrument may be moved about without fear of the light being blown out. The diaphragm is made of a plate of mica, and the same substance is placed over the aperture in the chimney. A good modification of the lamp has lately been made for me by Mr. Highley, which possesses some advantages over the one figured. It is probable that this may still be somewhat modified. The lamp is made to slide in the grooves marked *b*, *g*, Fig. 10, page 215, and it is fixed at the proper distance from the object by the screw. When required for reflected light it is placed in the groove marked *c*. In the other arrangement the lamp is made to slide on a horizontal bar which turns on a pivot, so that the position for reflected light is easily secured. A mirror is employed by daytime, and slides in the same groove as the lamp.

The achromatic condenser, polariscope, and drawing apparatus can all be readily adapted to this instrument, and from its simplicity it will probably be found very convenient for photographic purposes. The microscope, without powers, can be purchased for twenty-five shillings, and with the stand it will probably cost not more than three pounds.

In using the instrument, the object is first adjusted at an ordinary lamp, and when in focus, the microscope is placed in

the stand and firmly fixed in its place by the clamps. The lamp is then brought to its proper position, and the whole may be passed round. In about two minutes the specimen may be changed and another placed in its stead.

By this plan I have been able to show the preparations magnified from 215 to 700 diameters, to a class of 100 during an hour's lecture.

I am now having an arrangement adapted to the microscope which will enable me to use it for demonstrating structures with still higher powers. In the instruments used at my lectures recently given at the College of Physicians, I was able to use successfully all powers up to the twelfth (700 diameters), and I feel quite satisfied, that with some slight improvements the plan will succeed equally well with the highest powers which have ever been made.

These hand microscopes can also be readily fixed in a line, or in a six or eight-sided frame, in the centre of which the light to illuminate the whole may be placed.

The advantages of this arrangement for demonstrating to a class, is that while every one can alter the focus to suit his vision the preparation and light are quite out of reach. The various parts of the instrument will be readily understood by reference to Plate XIV, and to Fig. 10, page 215.

ON THE REDUCTION OF MICROSCOPICAL MEASUREMENTS TO A COMMON AND CONVERTIBLE STANDARD.

By R. Lawson, Director-General.

ENGLISH readers are much perplexed by foreign microscopic measurements, and however strange it may appear, the difficulty is enhanced on turning to those of their own country, for while foreigners employ a unit not familiar, they adopt a decimal notation which admits of their observations being compared one with another; but, though Englishmen employ a unit all are familiar with, its parts are written as vulgar fractions with such a variety of denominators that no one observed measurements are comparable with those of another, or even with his own in some other place, without previously reducing them to a common denominator.

A unit is required that will admit of microscopic measure-

ments being expressed in the smallest number of figures, and permit of foreign measures being easily converted into English, and *vice versá*, and the decimal notation should be adopted to facilitate comparison, between the measurements.

Most microscopic measurements are under the hundredth of an inch, and a hundred-thousandth of an inch cannot be measured with certainty. The requirements of the case therefore may be stated in decimals of an English inch by ·00101, and if the two ciphers next the decimal point be struck out, and the first number be considered the unit, it may be written $1^t·01$, in which a thousandth of an inch is the unit. This method will embrace nearly every microscopic magnitude in three consecutive figures.

The foreign measures are the millimeter and the French and Prussian lines. The two latter are so nearly equal, that in the small fraction required in the present subject they do not differ sensibly, and the same rule will serve for the conversion of both.

A millimeter contains ·03937 English inches or $39^t·37$; according to the method proposed, the length to be converted will seldom amount to one-fourth of this. To convert millimeters into thousandths, shift the decimal point one place to the right and multiply by 4; if greater accuracy be required, subtract $1\frac{1}{2}$ from the second place of decimals for each of the nearest number of units in the product. Thus $0^{mm}·250$ becomes $2·50$ which $\times 4 = 10^t·00$, from which subtract $^t·15$, and $9^t·35$ is obtained as the value in thousandths of an English inch, while $0^{mm}·25$ is equal to $9^t·84$, which differs from the former by a quantity too small to measure.

To convert thousandths of English inches into millimeters, add $1\frac{1}{2}$ in the second place of decimals for the nearest number of units in the sum, divide by 4, and shift the decimal point one place to the left, thus—to $9^t·84$ add $^t·15$ and the sum $9·999 \div 4 = 2·498$, and shifting the decimal point $^{mm}·2498$ which does not differ sensibly from $^{mm}·25$, the correct quantity.

A French line contains ·0888 English inches. To convert lines into thousandths of an inch, shift the decimal point one place to the right, and multiply by 9; if greater accuracy be required, subtract $1\frac{1}{3}$ from the second place of decimals for each of the nearest number of units in the product. Thus $0'''·125$ becomes $1·25$ which $\times 9 = 11^t·25$, from which subtract $^t·14$, and the value in thousandths is found to be $11^t·10$, which is correct.

To count thousandths into lines add $1\frac{1}{3}$ in the second place of decimals for each of the nearest number of units in the sum,

divide by 9, and shift the decimal point one place to the left, thus,—to 11ᵗ·10 add ᵗ·14, the sum 11·25 divided by 9, and the decimal point shifted one place to the left gives 0‴·125 as before.

In most cases it will be unnecessary to apply the corrections noticed above, but by remembering the short rules given, any one on reading a foreign work may correct the measurements as he reads, and insert them in the margin without delay, or interfering with his progress.

REPORT OF RESEARCHES PUBLISHED ELSEWHERE.

(ABSTRACT.)

ON THE DETECTION OF THE BILIARY ACIDS AND OF THE CHANGES THEY UNDERGO IN THE BLOOD.[*]

By Dr. Duffin.

IN the first volume of his Work on the Diseases of the Liver Dr. Frerichs published a novel and most ingenious theory to account for the production of jaundice in those cases where no mechanical obstruction of the hepatic ducts could be supposed to exist. He presumed that the consumption of the biliary acids which are reabsorbed into the circulation, either from the intestine or from the liver itself, might be checked at some stage of its progress. Instead of being ultimately converted in urinary colouring matters, these acids would only reach the transitional form of bile pigment, the gradual accumulation of which would tinge both the tissues and the secretions. This view was chiefly supported by the artificial production of colouring matters having the properties of bile pigment, and by the injection of the biliary acids into the blood of dogs, when bile colouring matters but no bile acids appeared in the urine.

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[*] Ueber die Nachweisung der Gallensäuren und die Umwandlung derselben in der Blutbahn. Von Dr. J. Neukomm.—Reichert's und Du Bois Reymond's Archiv, Heft III, 1860.

In a former number of the "Archives"* an extended analysis was published of a paper by Dr. Kühne,† contesting the validity of Frerich's experiments, and questioning the possible accuracy of the method of investigation that had been pursued. Kühne produced a series of counter experiments in which he employed a test recommended by Dr. Hoppe for the separation of the biliary acids from the urine. He thence concludes that in icterus from closed ducts the urine always contains biliary acids, whilst normal urine never affords any evidence of their presence. From the experimental administration of benzoic acid in cases of jaundice, when he asserts that no hippuric acid reached the urine, he further concludes that neither free glycin nor glycocholic acid is formed, but only possibly taurocholic acid. Lastly, whilst admitting that after the injection of glycocholic, cholalic, or choloidic acid into the blood a great amount of biliary pigment may appear in the urine, he is inclined to associate this phenomenon with the hœmaturia which is so apt to be present in these cases. He argues that in whatever manner the biliary acids reach the blood they have the faculty of dissolving the red corpuscles, and thus setting free the hœmatin which by some unknown process becomes converted into cholepyrrhin.

Views so radically antagonistic could not but provoke further investigation, and as early as the 11th of April, 1859, Dr. Folwarczny published the results of a short series of experiments absolutely contradictory to the first two conclusions of Kühne. He first applied Hoppe's method of extraction to six cases of normal and three of jaundiced urine, and in no instance was he able to detect even a trace of biliary acid. He then administered benzoic acid in four cases of jaundice, and invariably discovered hippuric acid in the urine by the following process. The urine was first evaporated to a syrupy consistence, and the residue extracted with alcohol of strength 0.83. The alcohol was next evaporated off by means of a sand-bath, and whilst this was proceeding a small quantity of oxalic acid was added. The residue was then again extracted with ether containing some alcohol, carefully evaporated, extracted with water, boiled and filtered hot. As the solution cooled hippuric acid crystallised out. Four-sided prismatic crystals were thus obtained in every instance. These when heated in a test tube dissolved to an oily fluid, and when warmed further yielded red, oily drops, possessing a peculiar aromatic colour.

But the results of a more extended and extremely careful

* Virchow's Archiv., Vol. XIV, Sept., 1858.
† Vol. I, p. 342.

series of experiments appeared in July last, in Reichert and
Du Bois Reymond's Archiv from the hand of Dr. Neukomm.
This observer remarks that Kühne acknowledges his inability,
even with the assistance of Hoppe's method of analysis, to
detect $\frac{1}{10}$ gramme[*] of dry oxbile in 500 cubic centimetres[†] of
urine with any degree of accuracy. Neukomm confined his
researches to the cholic and glycocholic acids, but for these he
investigated the whole question *de novo*. He began by ascer-
taining the absolute value of Pettenkofer's test. When 3 c.c.[‡]
of a solution containing $\frac{1}{10}$ per cent. of cholic acid was mixed
with two-thirds its volume of concentrated sulphuric acid and
one drop of a ten per cent. sugar solution was added, a fine
purple with a tinge of violet was obtained. When the solution
only contained $\frac{1}{25}$ per cent. of cholic acid, a weak vinous red
was obtained, whilst a solution of only $\frac{1}{100}$ per cent. only
yielded a very undecided yellow. It thus became important to
so modify Pettenkofer's test as to increase its accuracy. This
Neukomm attained to as follows:—He brought one drop of a
$\frac{1}{20}$ per cent. solution of cholic or glycocholic acid in contact with
one drop of a solution of sulphuric acid of the strength 1 part
sulphuric acid 4 parts water, to this a trace of sugar solution
was added, the whole was carefully heated in a small porcelain
dish, over a spirit lamp. A splendid violet resulted; now, as
one c.c. = 8 drops, it thus becomes possible to trace $\frac{6}{100}$ of a
milligramme (: 000924 grain.) of biliary acid distinctly. Even
1 c.c. of a $\frac{1}{100}$ per cent. solution, when evaporated down to a
drop yielded a fine purple, whilst 3 c.c. of the same gave no
response to Pettenkofer's test, as generally applied.

Employing this modification side by side with Pettenkofer's
test, he next ascertained the limits of Hoppe's method of
extracting the biliary acids. He employed first 0·1 gramme
(1·54 grain) and subsequently 0·05 gramme[§] of glycocholate of
soda, dissolved in 500 c.c. of urine. After extraction by lime
and hydrochloric acid, as directed by Hoppe, Pettenkofer's test
was found to fail with the first solution, although the porcelain
dish test gave an undecided reaction; but in the second solution
both tests proved utterly negative in their results. Returning,
then, to the old method of extraction by acetate of lead, it was
found that after the lead precipitate had been washed and
decomposed by sulphuretted hydrogen the sulphuret of lead
obstinately retained some of the biliary acids. To avoid this,
the lead precipitate was evaporated to dryness with carbonate of

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* 1·54 grain.   † 1 lb., 1 oz. 10·5 dr.
‡ 46·32 grain.   § ·770 grain.

soda. A biliary salt of soda could then easily be extracted by absolute alcohol, and transferred to a watery solution.

Four watery solutions of cholic acid were thus formed, the first containing 0·03 gramme of cholate of ammonia in 1000 c.c. of water, the second 0·02 grammes, the third 0·01, the fourth 0·005 grammes* of the cholate. The first only decidedly responded to Pettenkofer's test, but even the last offered a fine purple to the modification in the porcelain dish. Thus the method by precipitation with acetate of lead safely demonstrated cholic acid in a $\frac{1}{200000}$ solution. The same process being applied to the glycocholate of soda demonstrated it with certainty in a $\frac{1}{100000}$ solution. In order that this method of examination may be safely applied to the urine, it is necessary to extract the inorganic salts before proceeding to precipitate with the acetate. This can best be attained by evaporating the urine to a thick syrup, extracting with common alcohol, and again extracting with absolute alcohol. This last may then be driven off and the residue taken up by a little water. To obtain the greatest possible purity, the lead precipitate should also be extracted with boiling alcohol before it is converted into the soda salt. As small traces of the resinous urinary constituents may still be retained with the biliary acids and give a brownish reaction to sulphuric acid, the biliary salt may again be precipitated by the acetate, and a second time converted into the soda salt. The test was now transferred to the urine, and 0·005 grammes of cholic acid dissolved in 500 c.c. of urine, when extracted as above detailed, was found to yield a fine purple colour to the porcelain dish test. The same held true of glycocholic acid. Thus $\frac{1}{1000}$ per cent. of glycocholic acid can be demonstrated in urine, whereas Hoppe's method barely sufficed to indicate the presence of $\frac{1}{50}$ per cent.

These preliminary experiments being concluded, 500 c.c. of icteric urine, derived from a case of closure of the common duct, and yielding strongly the reaction of bile pigment to nitric acid, was carefully extracted by acetate of lead, as above indicated. Pettenkofer's test gave no evidence of the presence of a biliary acid, but on testing with the porcelain dish the usual purple colour was obtained. A second sample, consisting of 1200 c.c. of urine from a case of cirrhosis and softening of the liver, which behaved undecidedly to Pettenkofer's, gave the most positive evidence to the porcelain dish test. Neukomm now performed a number of experiments by injecting quantities of glycocholate of soda, varying from 0·8 to 2 grammes into the crural or jugular veins of a number of dogs. Upon a first animal three

* $\frac{1}{13}$ of a grain.

injections were performed at intervals of a fortnight each; upon a second two, and upon a third also two injections. The first experiment in which 0·8 grammes of the glycocholate was used, proved entirely negative. The urines in the second and third experiments, when 1·5 grammes and 1·3 grammes were injected respectively, gave distinctly the reaction of biliary colouring matter, but no trace of biliary acid either when analyzed by Hoppe's or the acetate of lead process. In the fourth experiment 2 grammes were injected into the circulation of a butcher's dog. The urine voided gave slight evidences of the presence of the biliary acids when tested by the porcelain dish plan. In the fifth the same quantity of bile acid was injected. The urine obtained, although affording indisputable proof of the presence of biliary colouring matters, gave no indication of any biliary acid. In the sixth instance 1 gramme only was used, the animal being a small terrier. In the first urine passed traces of biliary acids could be detected, but none in the samples subsequently analyzed. In the seventh the same quantity of biliary acid was employed. The evidences of biliary colouring matter were distinct, those of the biliary acids entirely negative. The amount of urine severally employed was the whole quantity obtained during the three days immediately succeeding the operation. This was divided into equal parts, the one treated by Hoppe's, the other by the lead process of analysis.

Thus in only two instances were any traces of the biliary acids detected, although, after making every deduction each specimen analyzed might have yielded a-half to a gramme. The quantity found is also too minute to lend any countenance to the idea that the bile introduced passes unchanged through the circulation into the urine. The minute quantity of five milligrammes was proved to be demonstrable in 1200 c.c. of urine in one of the experiments alluded to. Hence Neukomm concludes that the biliary acids can only appear in traces in the urine, and that the assertion of Kühne that "the soda combinations of glycocholic, and cholic and choloidic acids, when injected into the veins, leave the body of the animal," is disproved. Three of his experiments gave decided proof of the existence of biliary colouring matter in the urine; Frerichs found the same 19 times out of 29 injections that he performed, and Kühne invariably found them. These facts, Neukomm admits, seem to indicate a conversion of the biliary acids into chromogens in the course of the circulation, and ultimately into colouring matters. But he maintains that the exceptional cases are not to be estimated too meanly, and possibly the

conversion of the biliary acids may demand the concurrence of peculiar circumstances. Attacking the third of Kühne's propositions, that the biliary pigment observed is referrible to dissolved and modified hœmatin, he contends that Kühne's own experiments fail to bear it out. When Kühne injected dissolved hœmatin into the veins, no biliary colouring matters appeared in the urine, whereas, when biliary acids and hœmatin were injected simultaneously, the formation of pigment was observed. He is far from assuming that the hœmatin which is being destroyed in the body may not give rise to bile pigment, but he considers that this still remains to be proved. What method is employed to eliminate those portions of biliary acid which are not converted into bile colouring matter, is still a question.

JOURNALS WITH WHICH THE "ARCHIVES OF MEDICINE" IS EXCHANGED.

Glasgow Medical Journal.

Journal de la Physiologie de l'Homme et des Animaux, publié sous la direction du Docteur E. Brown-Sèquard.

American Medical Monthly.

North American Medico-Chirurgical Review.

Archiv. für die Holländischen Beiträge zur Natur und Heilkunde.

Guy's Hospital Reports.

American Medical Times. A new series of the New York Journal of Medicine.

Journal of Practical Medicine and Surgery. English Edition.

Quarterly Journal of Dental Science.

Ophthalmic Hospital Reports and Journal of the Royal London Ophthalmic Hospital.

Archiv. für Pathologische Anatomie und Physiologie, und für Klinische Medecin. R. Virchow.

Natural History Review.

London Medical Review.

Edinburgh Veterinary Review.

The Museum.

Maryland and Virginia Medical Journal.

₊ The Editor will be happy to exchange with any other Journals.

ANALYTICAL NOTICES OF BOOKS RECEIVED.

T. Holmes, M.A., Editor. A System of Surgery, Theoretical and Practical, in Treatises, by various authors.

The scheme of this great work is as follows:—I. The diseases which affect the whole system. II. Injuries which involve the whole, or a large part of the body, or which may be met with in any region. III. Local injuries. IV. Essays on local injuries, and the principles of operative and minor surgery, with the employment of anæsthetics. V. The surgical diseases of various organs, the eye, ear, nose, bones, joints, muscles, &c. VI. An appendix, which will comprise the principles of surgical diagnosis, the surgical pathology, and treatment of children's diseases, the construction and management of hospitals, and various miscellaneous matters. Vol. I. contains the following articles:—*Inflammation*, by John Simon; *Abscess*, by Holmes Coote; *Sinus* and *Fistula*, by J. Paget; *Gangrene*, by Holmes Coote; *Ulcers*, by J. Paget; *Erysipelas* and the allied diseases, by Campbell De Morgan; *Pyæmia*, by G. W. Callender; *Tetanus*, by A. Poland; *Delirium tremens*, by A. W. Barclay; *Scrofula*, by W. S. Savory; *Hysteria*, by W. S. Savory; *Syphilis*, by Henry Lee; *Tumours* (*Innocent*), by J. Paget; *Cancer*, by C. H. Moore; *Contusions*, by J. Paget; *Wounds*, by J. Paget; *Animal poisons*, by A. Poland; *Wounds of Vessels* by C. H. Moore; *Collapse*, by W. S. Savory; *Burns and Scalds—Accidents from lightning*, by T. Holmes; *General pathology of fractures*, by T. K. Hornidge; *General pathology of dislocations*, by T. Holmes. Analytical notices of the articles will appear in future numbers of the "Archives."

Dr. Miller. Elements of Chemistry: Theoretical and Practical. Part II. Inorganic Chemistry. London. 1861.

This volume treats of the chemical nomenclature, formulation, and arrangement of the elements. It then proceeds to review them and their compounds. It groups severally the halogens, the sulphur series, the alkalis, the alkaline earths, the metals of the earth, iron and its allies, the metals forming acids with oxygen, the copper series and the noble metals. A chapter is introduced on the general properties of metals, and on the theory of salts. The various metallurgic processes are described, and special paragraphs are devoted to alloying and assaying, in which the author has had considerable experience. The volume terminates in a chapter devoted to the circumstances modifying chemical affinity, in which the various electrolytic and photographic processes are described *in extenso*. The volume is abundantly illustrated with well-executed woodcuts.

Prof. Eckhard. Beiträge zur Anatomie und Physiologie. Zweiter Band. Giessen. 1860.

The present volume contains no less than six treatises by its editor, relating to the rapidity of diffusion through animal and vegetable membranes, anatomical and physiological researches into the salivary glands and nerves of the dog. and an investigation into the causes of the movements of the heart. It also contains monographs by Welcker, Hoffmann, Adrian, and Ordenstein. Two lithographs illustrate the work.

Prof. J. V. Carus and W. Engelmann. Bibliotheca Zoologica. Leipzig. 1861.

This work is a reasoned dictionary of the entire literature of zoology, which has at any time appeared in periodicals or in transactions, and of the books published between 1846–1860. Introductory catalogues of the means at the disposal of the zoologist, of the biographies of the great natural historians, and of the periodicals published throughout the world precede the bulk of the volume. The works relating specially to comparative anatomy and physiology, and to the geographical distribution of animals are classified apart. The literature of each of the great groups of animals is also classified separately. The present volume has only proceeded as far as reptilia, but the completion of the series is promised in the course of a few months. The present volume comprises 950 pages of close print. The whole is admirably and most accurately printed, and the work will be indispensable to naturalists.

Dr. Ernest Godard. Etudes sur la Monorchidie et la Cryptorchidie chez l'homme. Paris: 1 vol., 8vo, 164 pages. 1857.

The author applies the terms monorchidie and cryptorchidie to that abnormal condition in which one or both testicles have not completely descended into the scrotum. Hereditariness, imperfect development, orchitis or a bad position of the gland in the inguinal canal are given as its exciting causes. Both testicles may be healthy, the one which has had its migration arrested may be alone diseased, that in the scrotum may alone be diseased, or both testicles may be in a pathological state. The conclusion is drawn that where both testicles, although developed, are incompletely descended, the subjects are irrile, ejaculate semen deprived of spermatozoa, and cannot fecundate. The work is illustrated with some very beautiful plates. M. Godard had previously published a memoir on the same subject in 1856.

Dr. Ernest Godard. Recherches sur la substitution graisseuse du Rein. 32 pp.

The literature of fatty degeneration in general, then of that of the kidney are discussed. The observations made by M. Godard lead him to believe that fatty substitution of the kidney is essentially characterized by the deposition of a variable quantity of fat, either in the substance of the glandular parenchyma, or at its periphery; but, nevertheless, within the capsule, or in the hilum of the organ. The fat then penetrates between the mucous membrane and the pyramids, and gradually leads to atrophy of the kidney.

Dr. Ernest Godard. Recherches teratologiques sur l'appareil séminal de l'homme. 1 vol., pp. 152; 14 planches lithographiées. Paris. 1860.

After some general considerations on the physiological offices of the various glandular parenchymata, the congenital absence of one or of both testicles is discussed. The varieties of these anomalies are severally analysed together with their diagnosis. The influences of unilateral, and of double congenital orchidia on the generative functions, the general conformation, the physical powers, the intellectual, and moral faculties, the voice, etc. are discussed separately. A chapter is also exclusively devoted to the congenital absence of the excretory ducts, the testis being in a normal condition. The engravings which illustrate this work are numerous and well executed.

Dr. Wilks and Mr. Poland, Editors. Guy's Hospital Reports. Third Series. Vol. VI. London. 1860.

Dr. Taylor has contributed three papers to the present volume, one of them on the facts and fallacies connected with the research for arsenic and antimony in organic matter, and another on a case of poisoning by white precipitate to which Dr. Pavy has appended a series of experiments on the physiological actions of that drug. Mr. Durham has also contributed three papers, one on the physiology of sleep. In this the conditions of the organ upon which this inactivity depends, and proximate causes of such conditions are experimentally and pathologically discussed. A number of clinical chapters on the surgical disorders of the respiratory and circulatory organs, from the pen of Mr. Bryant, commence the volume. Dr. Wilks has contributed a paper on some of the diseases of children, more especially of those affecting the brain and its membranes, the larynx, and the respiratory organs within the thorax. Dr. Habershon has contributed an interesting series of cases of hydatid disease, whilst Dr. Odling gives an account of the well at Guy's Hospital, including a description of the geological section, and an analysis of the water obtained. Mr. Birkett continues his series on new growths, or tumours. Cases are contributed by Dr. Hicks, Messrs. France, Salter, and Poland. Many of the papers are illustrated.

Dr. Tanner. On the Signs and Diseases of Pregnancy. London. 1860.

This work opens with a general account of the statistics of menstruation and pregnancy, with a sketch of the comparative physiology of generation, and with an analysis of the mortality from childbirth in England and Wales, in 1857. The author next discusses the nature and value of the several recognized signs of pregnancy, then the diseases which simulate it, particularly ovarian and uterine enlargements. He devotes a chapter to the consideration of the evidence, both human and comparative, that we possess on the duration of pregnancy, referring to M. Tessier's and Earl Spencer's statistics, and to Dr. Clay's opinions. Thence he passes to the pathology of the pregnant state, reviewing severally the causes leading to the premature expulsion of the fœtus, extrauterine fœtation, etc., and devotes an entire chapter to a description of the substances that may be expelled from the uterus. The nervous disorders that may be associated with gestation are also reviewed at large, together with the reciprocal influence of this state upon pulmonary, cardiac, and uterine affections. The sympathetic affections of digestion, respiration, circulation, and of the nervous system are also treated of under separate heads. Two chapters are appended to this work, the first on the diseases of the urinary and generative organs ; the second on the displacements of the gravid uterus. The volume contains 490 pages.

Dr. Meadows. On the Admission of Air into Serous Cavities. London. 1860.

The author considers that tradition has been allowed too much importance in regulating our conduct in this matter. He is inclined to ascribe the prejudicial results of puncture of the pleural cavity rather to collateral concomitant circumstances. He questions whether the admission of air is as frequent as is usually allowed, and describes experiments made by Mr. Heath on the effects of removal of portions of the thoracic wall on the subjacent lung. He cannot admit the grounds upon which the exclusion of air from an inflamed serous surface is so strenuously enjoined. He concludes by recommending the presence of air to be entirely disregarded, provided only the air be healthy, and gives general directions for treatment.

Dr. Kirkes. Handbook of Physiology. Fourth Edition. London. 1860.

The general arrangement of this edition is based upon the principles adopted in its predecessors. Much new matter is introduced. Among other things the recent views on the coagulation of the blood, held by Richardson, Brücke, and Lister, are adverted to. Lehmann's analyses of blood crystals are given, and an abstract of part of Mr. Paget's Lectures on the " Life of the Blood" is introduced. The recent researches of Paget, Brown-Séquard, and Lister, into the causes of the rythm of the heart also take their place in the chapter on circulation. Wiederhold's statements that chloride of sodium, uric acid, urate of soda, and ammonia may be detected in the expired air, are noticed in the chapter on respiration, as are also Mr. Erichsen's observations on death by asphyxia. Under digestion, Dr. G. Harley's statement on the presence of iron in the healthy human saliva is adduced, as are also Bernard's recent experiments in the amount of that fluid daily secreted, and on the influence of the vagi on the secretion of the gastric juice. Kölliker's recent researches on the structure of the villi are also introduced. The recent discussions into the glycogenic functions of the liver, and the offices of the pancreatic juice occupy their respective places. The experiments of Bernard and Brown-Séquard on the influence of the nervous system on secretion receive due attention. Under the article on the nervous system, considerable stress is laid upon Brown-Séquard's recent investigations into the functions of the spinal cord and medulla oblongata. Like its predecessors this work is abundantly illustrated with engravings.

Mr. Buckton. On the Stibethyls and Stibmethyls.

Includes a series of experiments undertaken to ascertain how far the compounds of antimony with methyl and ethyl were limited to the ammonia type, or whether bodies might arise referable to the types of antimonious and antimonic acids. The author concludes that the higher stibium organo-radicals exist. He gives confirmatory experiments.

Prof. Alphonse Mariette. Introductory Lecture delivered at the opening of the Evening Classes of King's College, London, for the Winter Session. 1860—1861.

The origin and growth of this branch of education are adverted to, together with the statistics of attendance. The relations of teacher and pupil are discussed, and the several branches of instruction reviewed. The Volunteer movement in both its military and social aspects concludes the lecture.

Modern Medicine: its Aims and Tendencies, being the President's Address at the 28th Anniversary Meeting of the British Medical Association. Torquay. 1860.

The constitution of the association is first alluded to ; then the recent strides of general science are indicated, and their application to commercial science insisted upon. The recent advances of medicine are reviewed, and the causes and characters of medical differences analysed. Medical politics and medical celebrities are also introduced,

Dr. Turner. Observations on the Trichina Spiralis.

The literature of the question is reviewed, and a series of experiments instituted, confirming the views with reference to the wanderings of the trichinæ from the intestine to the muscles, and their becoming encysted there.

Dr. Roberts. Quarterly Meeting of the Lit. and Phil. Society. Manchester. October, 1860.

Among the papers read was one by Dr. W. Roberts, on a method of estimating the sugar in diabetic urine, by the loss of density after fermentation. Each degree of density lost indicates one grain of sugar per fluid ounce of urine. Dr. Smith, the chairman, read a paper tending to prove that the amount of arsenic in coal pyrites is not without some influence in towns where specimens of certain coals are consumed. Methods of mounting insects are also discussed.

Dr. Turner. On the Employment of Transparent Injections in the Examination of the Minute Structure of the Human Pancreas.

The author has succeeded in forcing Dr. Beale's Prussian blue solution into the ultimate follicles of the pancreas. He believes the membrane forming the wall of the follicles to be connected with that forming the wall of the duct. An engraving illustrates the pamphlet.

Mr. Lister and Dr. Turner. Observations on the Structure of Nerve Fibres. London. 1859.

These observations were undertaken to determine the nature of some appearances seen in sections of the spinal cord, prepared by Mr. Lockhart Clarke. Portions of cord and of sciatic nerve were steeped in chromic acid and carmine, and examined by transmitted and reflected light. The conclusion arrived at is that the transparent rings seen in Mr. Clarke's preparations are the white substance of Schwann rendered transparent by turpentine. A coloured engraving illustrates the pamphlet.

Dr. Turner. Remarks on the Musculus Kerato-Cricoideus.

After quoting Dr. Merkel's description of this muscle, the author gives as the result of his own dissections, its presence in seven out of thirty-two specimens, chiefly in males, and proportionately to the development of the other laryngeal muscles. A drawing is given, illustrating the portion of this muscle.

Dr. Turner. Case of Extensive Adhesion of the Inferior Margin of the Soft Palate to the Posterior Wall of the Fauces.

The author gives a description of the parts seen in dissection, and directs attention to analogous cases by Rudtorffer and Flower. The paper is illustrated by two engravings.

Dr. Turner. The Thyroid Gland in the Cetacea.

The dissection of the thyroid and thymus in the porpoise shows a connection between these bodies in the non-fœtal state. The dissection of the nylghau and the hartebeest shows that in these antilopidæ the thymus is a permanent gland. The author has also seen indications of a close connection between the thymus and thyroid glands in the human subject. Two engravings illustrate this pamphlet.

Dr. John C. Dalton, Jun.   The Physiology of the Circulation : a Course of Lectures delivered at the College of Physicians and Surgeons.   New York, in the Fall Term of 1859.

In the first lecture the author refers generally to the subject of the course, and particularly insists upon the importance of the greatest caution in drawing conclusions from physiological experiments on living animals.   The result of an experiment is one thing, and our interpretation of the result is another.   It is very important to experiment on the same species of animal, and each individual should be in a state of good health at the time.   The result of the same injury in different animals is very different.   Paralysis of the portio dura in the horse is fatal, because a branch supplies the muscles which preside over the movements of the nostrils, which alone form the breathing apertures of this animal. A certain reserve must, therefore, always be exercised in applying the results of experiments on the lower animals to man.

The second lecture comprises the structure and action of the heart, the action of the valves, the position of the heart in the chest, illustrated by reference to four subjects, the trachea having been tied before removing the sternum to prevent collapse of the lungs.   Then follows a reference to the case of M. Groux, in whom there existed a congenital fissure of the sternum.

In the third lecture the action of the heart and lungs is shown in a dog recently poisoned by woorara, artificial respiration being kept up.   The heart exhibits a continuous and peristaltic movement which commences at the auricles, and gradually extends forwards to the apex of the ventricles.   When respiration is suspended, the venous blood accumulates not only in the right auricle, but also distends the right ventricle.   In M. Groux, during a prolonged expiration, the right ventricle became distended.   The left cavities are also distended in imperfect respiration in consequence of the blood moving backwards from the general system.   *The aorta, and the commencement of the arterial system become distended at the same time as, or even before, the right side of the heart.*   These points were proved experimentally.   The alterations in the phenomena of the circulation occurring in asphyxia are very fully considered.

The fourth lecture comprehends the consideration of the nervous influences affecting the heart's action, the cause of the rythmical character of the pulsations, the continuance of the heart's action after the destruction of the medulla and spinal cord, the effects of narcotic poisons on the heart, the mode in which anasthetics prove fatal, and the action of hydrocyanic acid, woorara, and the different varieties of woorara.   Woorara produces paralysis of the voluntary muscles without exerting any direct influence on the heart.   Dr. Hammond sent the author a specimen of corroval which, however, acts in an opposite manner to other varieties of woorara.   It stops the action of the heart, and exerts little or no direct influence on the voluntary movements.

Dr. Hughes Bennett.   An Address to the Graduates in Medicine.

Although the examinations are over, and licences to practice obtained, the author insists upon the importance of graduates still continuing their studies. Dr. Bennett fully considers the alterations which have lately been carried out with reference to the curriculum of study, and gives an account of the mode of government and the political state of the profession.   "I believe as firmly now as when I sat on the very benches you now occupy to receive my own degree, that the only method of producing good practitioners and teachers of medicine is a sincere and persevering determination to investigate the nature and treatment of diseases."   The following is one of the concluding sentences of this address : —" Maywe not hope that our science, which has for its object the well-being of man on earth, if rightly understood, and assisted by religion, will some day, in like manner, enable us to view more clearly the mysterious connection which unites his physical and spiritual nature hereafter ? "

INDEX TO VOLS. I & II.

EXPLANATION OF PLATES.

The scales at the bottom of each Plate represent hundredths or thousandths of an inch magnified in the same degree as the object delineated.

PLATE I.

To Illustrate Messrs. Taylor and Hulme's Cases, illustrating the use of the Ophthalmoscope (p. 14).

Fig. 1. Right eye of a girl aged 20, showing bluish grey shade around optic disc. The patient was quite blind with this eye. Two or three spots of pigment are seen below the optic disc.

Fig. 2. Right eye of same patient, with effused blood over the situation of the yellow spot, from rupture of the vessels of the choroid. The blue spots seem to be unabsorbed blood clots.

Fig. 3. Choroidal congestion with clot of blood, as seen a few days after the patient had had a blow over the right eye.

Fig. 4. Right eye of a woman, aged 61, showing changes in choroid resulting from a blow received five years before. The choroid has completely wasted over the colourless space represented in the drawing.

Fig. 5. Left eye of a boy 12½ years old, myopic, with thin sclerotic, and slight posterior staphyloma.

Fig. 6. Extreme myopia of left eye, small optic disc, with hyperæmia of its surface.

PLATE II.

To Illustrate Dr. Beale's Observations on a Case of Fatty Degeneration of the Central Parts of the Lobules of the Liver (p. 41).

Fig. 1. General view of several lobules. Portal vein injected. The dark parts in the centre of the lobules indicate the situation of the development of the fatty matter.

Fig. 2. Small interlobular fissure, showing injected ducts, and their connexion with the cell-containing network.

Fig. 3. Segment of a lobule, in which the hepatic vein (*a*) was injected, showing capillaries in the centre of the lobule, with their meshes, occupied with large oil globules, which gradually diminish in size towards the portal aspect of the lobule.

Fig. 4. Fragments of the cell containing network, from the centre, and nearer the portal aspect of the lobule, more highly magnified.

Fig. 5. Another fragment.

Fig. 6. Portion of a lobule in which the portal vein was injected, showing fatty matter in the centre of the lobule, and the granular appearance of the cell containing network, near the circumference of the lobule.

Fig. 7. Narrowest portion of the duct showing its continuity with the cell containing network, more highly magnified. The granular appearance of the network near the circumference of the lobule, is seen to depend upon the presence of small oil globules and fatty matter in a granular state.

PLATE III.

To Illustrate the Microscopical Characters of the Sputum in Mr. Newham's Case of Cancerous Growth in the Pharynx, with Drawings of the Tumour itself. From a Drawing by Dr. Beale (p. 44).

Fig. 1. Shows the various forms of the so-called cells in the sputum. These are clearly not cells, but fragments of a mass containing, irregularly scattered through it, nuclei or small cells. At *p*, is represented a piece from the lower part, of which the nuclei and portions of the mass surrounding them have been broken off, leaving cup-shaped cavities in which they were lodged.

Fig. 2. Portion of the tumor itself obtained after death.

Fig. 3. Portion of a cervical gland.

PLATE IV.

To Illustrate Mr. Lee's Remarks on Trephining in Syphilitic Diseases of the Bones of the Skull, (p. 78). *From Drawings by Dr. Westmacott.*

Head and face of girl showing the exposed and necrosed portion of frontal bone; an unhealthy ulcer under the chin and the lobe of the ear, a portion of which has been removed by ulceration.

a. The internal surface of the portion of the frontal bone removed by the trephine.

PLATE V.

To Illustrate Mr. Lee's Remarks on Trephining in Syphilitic Disease of the Bones of the Skull, (p. 81). *From a Drawing by Dr. Westmacott. Necrosed Skull seen from within.*

a. Necrosed portion of inner table of skull, the outer table not being affected in the same way.

b. Openings left by removal of portions of the skull partially closed by membrane.

PLATE VI.

To Illustrate Dr. Ogle's Remarks on False Membranes in connection with the immediate coverings of the Brain (p. 90).

False Membranes of variable thickness lining the cerebral dura-mater.

a. a. The dura-mater.

b b. The falx cerebri.

c. c. c. Layers of false membrane capable of being subdivided by splitting.

d. d. Veins passing into the superior longitudinal sinus thickened and covered by false membrane.

PLATE VII.

Outline of the Male Chest to Illustrate the Physical signs in the case of ' Charles Rome ' (p. 92). *Also Dr. Beale's Remarks on a simple and accurate Method of Recording Physical Signs* (p. 97).

Fig. 2. Second rib. Fig. 3. Third rib. *a.* Shows the limit of the dulness from January 20th to February 3rd. *b.* Limit of dulness on February 4th. *c.* On the 6th The dots in the space *d* indicate the points at which the rubbing sound was heard on the 24th; over the entire space *d* on the 26th.

PLATE VIII.

Outlines of a Female Chest to Illustrate Dr. Beale's Remarks on a simple and accurate Method of recording Physical Signs (p. 97).

PLATE IX.

To Illustrate Dr. Martyn's Remarks on Connective Tissue (p. 99).

Fig. 1. Transverse section of adult human tendo Achillis, half dried, magnified 300 diameters. Stellate bodies are seen, some of them with corpuscles in the centre, some with communicating radii. They are really spaces between the ultimate bundles. Between them are seen the cut across elastic fibres.

Fig. 2. Longitudinal section of tendo Achillis, from infant at birth; half dried, and treated with dilute acetic acid. The cells of connective tissue are seen to become, and give origin to, the true nuclear fibres, or young elastic tissue. The cells do not send off transverse runners. In adult tendon the cell and nucleus appear more as a thickened part of the fibre. Magnified 300 times.

Fig. 3. The same object as in fig. 1, treated with dilute acetic acid. The star-shaped forms have disappeared, and the cells are seen to have pieces of elastic fibre attached to them corresponding to the thickness of the section. The preparation is disturbed by swelling up, and its edge shows the appearances of fig. 2.

Fig. 4. Cells in a frond of porphyra, showing that what is called *inter*cellular substance is really resolvable into layers or laminated "mother cells." The degree of lamination is in proportion to the development of the group.

Fig. 5. Compound capsular matrix of hyaline cartilage (cricoid of lamb). The old capsule of the large group has pushed outwards the granular remains of still older capsules. Magnified 300 diameters.

Fig. 6. A diagram to illustrate the cell growth in figs. 4 and 5. If the cells a, b, and c happen to be under observation, b will appear to be separated from c by intercellular matrix, while its capsule (cellular wall) is in contact with that of a. [The older capsules blend more and more, and are pressed into receding angles between the spheroidal groups, as they become dilated.]

PLATE X.

To illustrate Mr. Lee's Cases of Trephining in Syphilitic Disease of the Bones of the Skull. (Page 78.)

CASE II, p. 80.—Ulceration involving the whole of the skin of the right arm. Healed after trephining the right parietal bone. The ulceration was probably caused by reflex nervous irritation originating in disease of the bones of the skull, and producing fits of severe muscular spasms, sometimes of several hours' duration.

PLATE XI.

To illustrate Dr. Begbie's Case of Mediastinal and Pulmonary Cancer. (Page 145.)

Fig. 1, *a.* Represents region of dull percussion, &c., on the occasion of patient first applying at the Infirmary.

b.—The entire front yielding dull percussion, when fluid had accumulated.

c.—The region of clear percussion and restoration of faint vesicular breathing, for a limited period, after the larger tappings.

4.—The site of the operation of paracentesis on two occasions.

Fig. 2. *b* and *c* correspond with *b* and *c* in fig. 1.

PLATE XII.

To illustrate Dr. Beale's Paper on the Structure of Tissues. (Page 179.)

Fig. 1. Germination and growth of common mildew stained with carmine, × 1700.

a.—Spores slightly swollen, showing *formed material* outside and *germinal matter* within.

b.—Spherical particles of germinal matter set free from a spore.

b ×.—Spore, with its external envelope of formed material opened.

c.—Spherical particles of germinal matter within spore increasing in size and dividing. Pores visible in envelope.

d.—Some of the particles of germinal matter have increased at one point, and have extended from the spore. They continue to grow rapidly, being protected only with a thin layer of *formed material.*

e.—A spore which has much increased in size, but from which no off-shoot has proceeded. The thick successive layers of formed material are seen. The oldest layer is outside, the youngest in immediate contact with the germinal matter.

f.—A spore from which an off-shoot has proceeded. The germinal matter of the off-shoot has been destroyed, while that of the spore retains its vitality.

g.—A part of the thallus, the germinal matter of which is dead. The external tubular membrane retains its physical characters.

h.—Portions of thallus in which the germinal matter is increasing most rapidly in certain spots. Here branches are formed.   *i.*—A young branch.

k.—An older part of the thallus, showing the septa of formed material and the points at which the germinal matter was originally continuous. The *formed material* is thicker than in *h* or *i*, and the germinal matter is a little shrunk within its tube.

l.—A spore from which an off-shoot has proceeded. The germinal matter is seen to be very thin at the summit, where growth is occurring most rapidly.

m.—Spore with two off-shoots from opposite surfaces. These have grown and are giving off branches, but the continuity between the germinal matter in these and that in the spore still exists.

n.—The germinal matter of the spore is dead, and forms a collapsed mass within, while that in the off-shoot retains its vitality and is increasing.

o.—A very old spore which has germinated and grown much larger. An off-shoot has also proceeded from it, but, from being exposed to conditions unfavourable to its free extension, the *formed material* has increased enormously in thickness by the deposition of successive layers on the internal surface.

p.—A part of one of the stems which grow into the air, bearing on its summit oval capsules, from the germinal matter of which the spores are formed.   *r.*—A separate capsule.

Fig. 2. Two portions of the stem of a sea-weed.

a.—The summit of a growing shoot. Vegetable organisms grew upon every part of the outer layer of the formed material. This is increased in thickness by the deposition of new layers from the germinal matter. The continuity between the masses of germinal matter is still seen.

b.—From an older part of the stem, showing the mode of formation of the spores.

Fig. 3. A thin section of a very rapidly growing simple fungus. At *a* are seen portions of the simple membranous walls of large spaces, in which the masses of germinal matter were situated.

b.—Some of the smallest masses of germinal matter, entire and separated into their component spherules, magnified 1,700

diameters. It was not possible to demonstrate the *formed material*, in many specimens.

c. Larger masses of germinal matter magnified 700 diameters.

These figures illustrate the following points :—

1. That every living organism, and every elementary part of an organism, consists of matter in two states. *Germinal matter,* growing, active, undergoing change. *Formed material,* which has been formed from the germinal matter, passive, and not capable of growing or of selecting nutrient substances.

2. That the *formed material* is on the outside of the germinal matter, and is increased in thickness by the deposition of new matter on its *inner* surface. The *outer* part of the formed material is the oldest; the inner that which has only just passed from the state of germinal matter.

3. That the masses of germinal matter are composed of smaller spherical particles, and these, again, of smaller spherules. (Fig. 1 *b,* fig. 3 *b.*)

PLATE XIII.

To illustrate Dr. Sansom's Observations on the Action of Chloroform upon the Blood. (Page 170.)

Fig. 1. Blood corpuscles of frog.   Normal.

Fig. 2. The same, modified by slight exposure to the vapour of chloroform.   Elongation of cells and puckering of cell-walls.

Figs. 3 and 4. Other cells, modified by exposure to chloroform-vapour.   Partial solution; amalgamation of contents.

Fig. 5. Complete solution of corpuscles by liquid chloroform.

PLATE XIV.

To illustrate Observations on the Urine and the Structure of the Kidney, in a Case of Acute Suppurative Nephritis. (Page 286.)

Fig. 1. Casts from the urine, three days before death, containing cells like pus, and blood corpuscles.

Fig. 2. A portion of a cast, magnified 700 diameters, showing cells in the central part resembling white blood corpuscles or pus corpuscles. They have probably multiplied while they were entangled in the coagulable material of the cast.

Fig. 3. Separate cells from the urine.   *a.* A cell, the granular contents of which form several masses (nuclei), all of which would become corpuscles if set free.   *b.* A cell, with two

nucleus-like bodies. *c*. A smaller cell. *d*. Blood corpuscles. Several of the cells figured are a little distended by the endosmose of fluid. *e*. A long tailed body, several of which were present in the urine. The central part became coloured by the action of carmine, and was therefore composed of germinal matter.

Fig. 4. A portion of a cast with several distinct cells showing nuclei and granular contents.

Fig. 5. A portion of a capillary vessel of the kidney distended with altered white-blood corpuscles.

Fig. 6. A portion of one of the capillary loops of a Malpighian body, distended with modified white blood corpuscles, and showing the nuclei *a* connected with the capillary walls.

Fig. 7. Bodies found between the capillaries of the Malpighian body and the walls of the capsule. They are probably altered cells, similar to those found in the casts. From them soft fibrous structure may be seen projecting.

Fig. 8. Round flattened cells from the inner surface of the capsule of the Malpighian body.

PLATE XV.

To illustrate Dr. Beale's Lectures on the Nutrition and Growth of Tissues. (Page 207.)

Fig. 1. A fully-formed starch-holding cell of the common potatoe. The primordial utricle has been removed from the lower half, in order to show the starch globules within more distinctly. The nucleus and nucleolus are seen in the remaining portion. Around are portions of neighbouring cells, the walls of which are separated here and there by compressed bubbles of air indicated by the very dark shading. On the left are seen some elongated cells with nuclei and nucleoli. These probably become spiral vessels.

Fig. 2. One of the large cells with thick walls, containing little starch, but exhibiting pores which are, however, closed externally by a thin layer of the original capsule (cell-wall).

Fig. 3. A piece of the wall of one of the cells figured in 2, magnified 700 diameters, showing the manner in which the material applied to the thickening of the wall is added, layer after layer, upon the inner surface. The innermost layers are the highest in the drawing.

Fig. 4. Five young starch-holding cells of the potatoe, showing the outer thin layer of formed material (cell-wall), the germinal matter (primordial utricle), with small starch globules precipitated amongst it, the nucleus and nucleolus.

*The following six figures are intended to illustrate the struc-
ture of elementary parts, according to the view given on
pages* 228—230.

Fig. 5. An elementary part. Spherical particles of germinal
matter composed of smaller spherules. The smallest visible
spherules are only represented in one or two instances. The
quiescent portion of the germinal matter (nucleus) is indicated
by the dark outline of the spherules.

Fig. 6. Supposed structure of one of the smallest component
spherules of Fig. 5, very highly magnified.

Fig. 7. Germinal matter and formed material of a structure
like the liver cell. At the outer part the formed material
is gradually being resolved into biliary and other con-
stituents.

Fig. 8. Germinal matter and formed material of ordinary
tendon.

Fig. 9. Diagram to show the manner in which fatty matter
and other substances resulting from changes occurring in the
germinal matter, accumulate in its central part. The germinal
matter at last forms a very thin layer between these particles
and the formed material of which the investing membrane or
cell-wall is composed.

Fig. 10. Diagram to show the manner in which the pores
in certain vegetable cells, and the canaliculi of bone are left
during the deposition of hard matter from without inwards.

PLATE XVI.

To illustrate Dr. Beale's Paper on a New Form of Pocket Clinical Microscope. (Page 289).

Fig. 1. The microscope, half the real size. *a.* Tube carrying
the eye-piece. *b.* Tube carrying the object-glass. *c.* Outer
tube to which the stage is attached. * Bolt, which can be
fixed at any height by a tooth and rack. *d.* Little screw, also
shown in fig. 4. *e.* An aperture for throwing light on opaque
objects. *f.* Part of the spring which retains the preparation
against the stage, also shown in fig. 7.

Fig. 2. A smaller drawing, showing a screw round the upper
part of the tube *c*, fig. 1, for the purpose of fixing tube *b* in
position when the proper focus has been obtained. This super-
sedes the necessity of the bolt marked by * in fig. 1.

Fig. 3. Pocket mirror.

Fig. 4. Screw-clamp to fix the specimen in one spot.

Fig. 5. Cell, with adjusting cover, for examining urine.

Fig. 6. Under surface of the body or stage, showing the flat

rim *g*, upon which the slide is placed.   *h*. The under surface of
the object-glass.   *f*. The spring.

Fig. 7. The stage, which unscrews from the lower part of
the body.   The shape of the spring (*f*) is represented.

Fig. 8. The lamp, shown in section.   *h*. Orifice, closed by
mica, through which the light shines.   *i*. Reflector.   *k*. Dia-
phragm to create an ascending current of air.   *l*. Screw for
fixing the foot in the groove.   *m*. Perforated wire gauze on the
top of the shade. This slides in the grooves of the stand *b* and *g*,
fig. 10, p. 217.

Fig. 9. Mirror for sliding in the same groove, for use when
the instrument is employed for class purposes by day in a room
with a skylight.
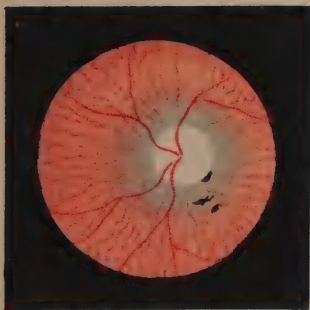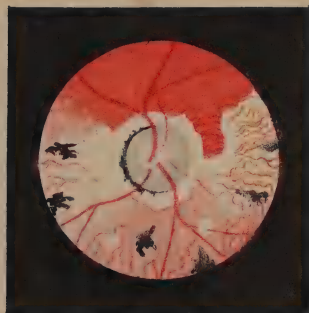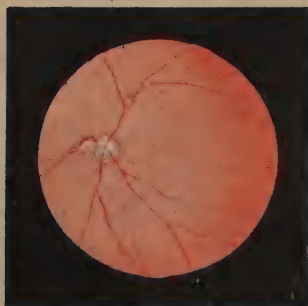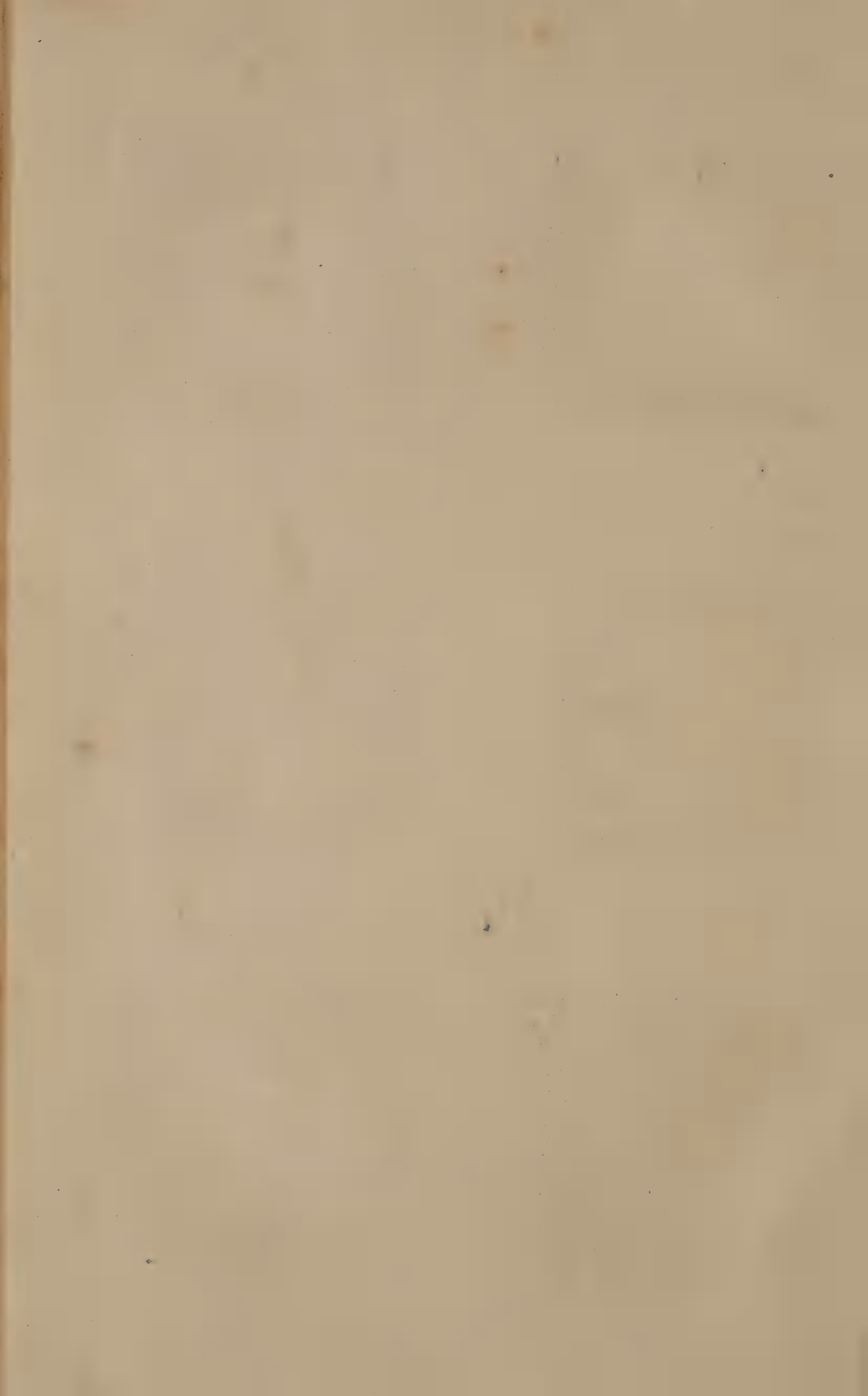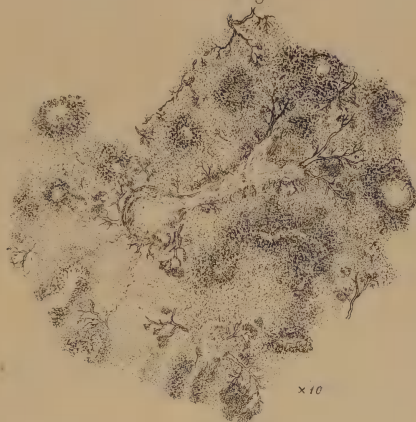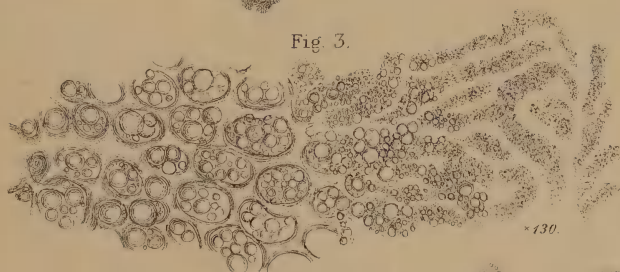
PLATE I.

PLATE II.

Fig.1

Fig. 2

×10

×42

Fig. 3.

×130.

Fig 5

×215

Fig. 4.

Fig. 6

×42

Fig 7.

×215.

100 ths		×10
100 ths		×42
1000 ths		×130
1000 ths		×215

Fig. 1.

PLATE III.

Fig. 2.

Fig. 3.

×215

×215

×215

L.S.B. 1860.

1000ᵀᴴˢ

×215

ARCHIVES.

PLATE VI.

PLATE VII.

PLATE VIII.

PLATE IX
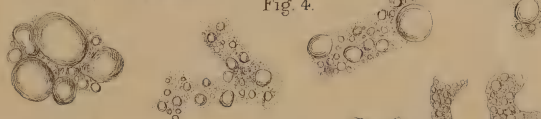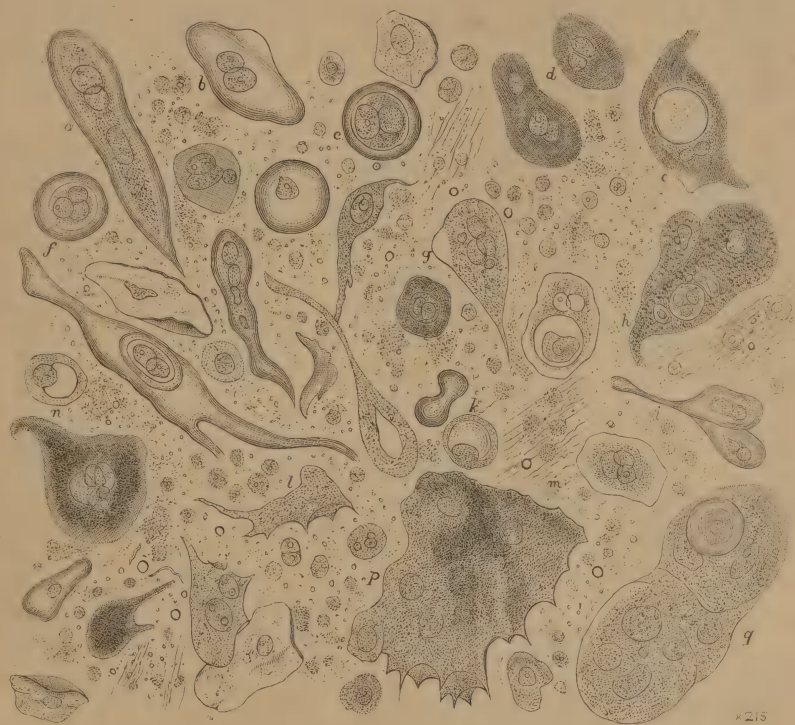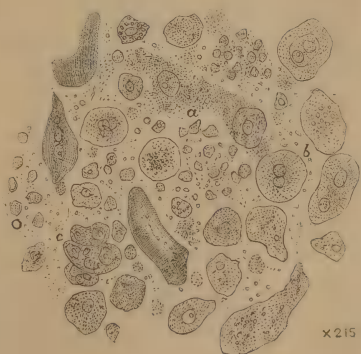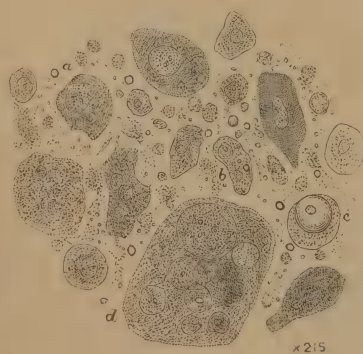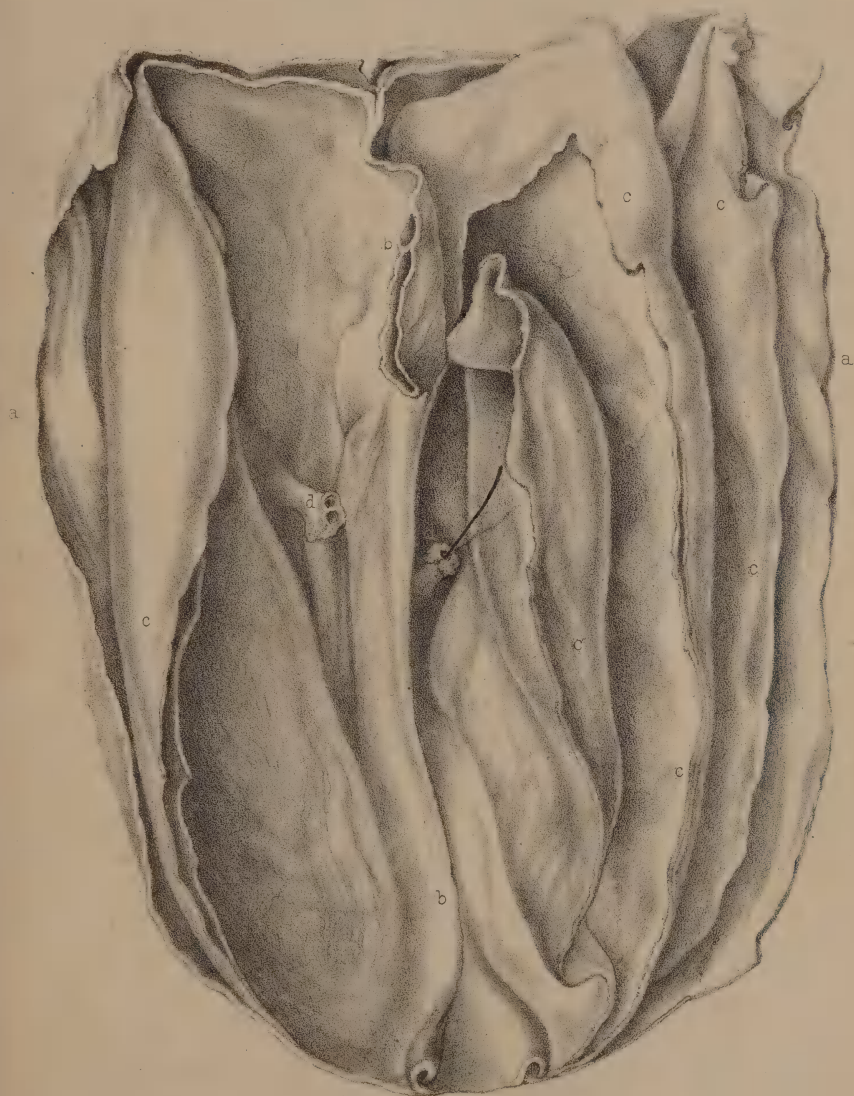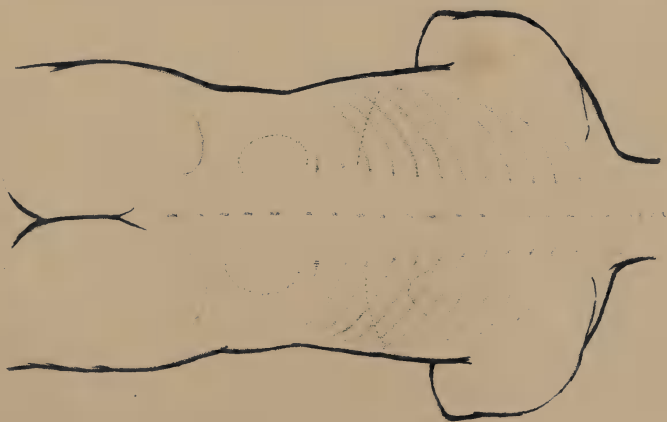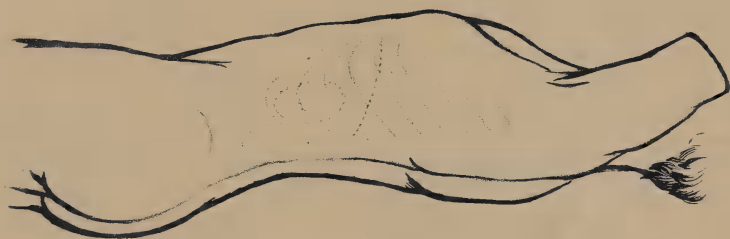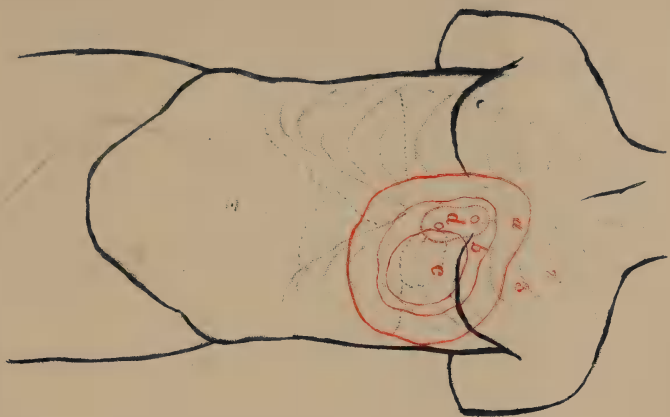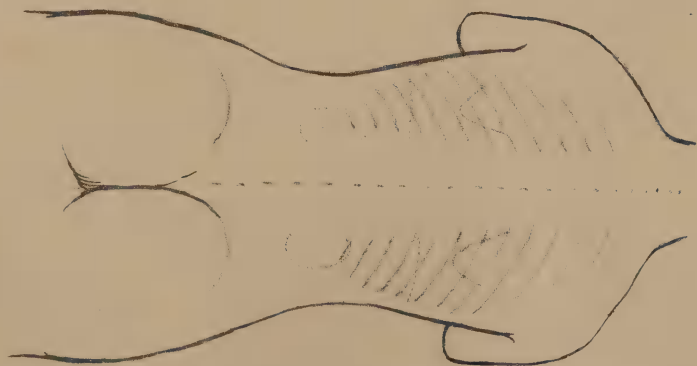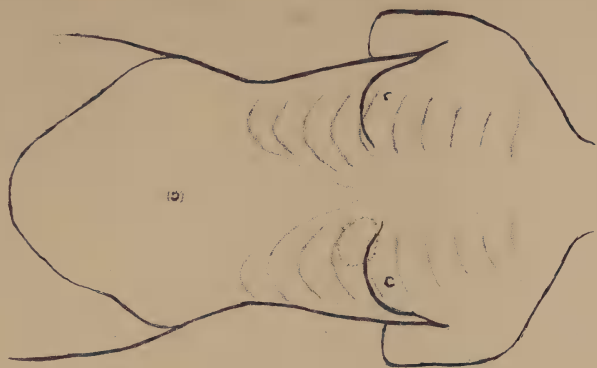
Fig.1
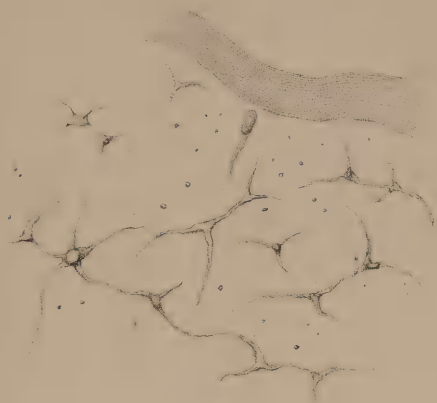
Fig.2.

Fig.3.

Fig 4.

Fig.5.

Fig.6.

a b c

PLATE X.
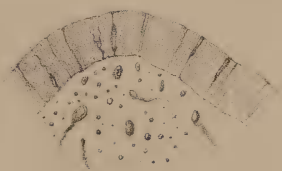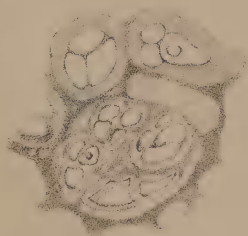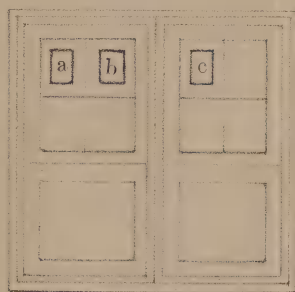
...............Part trephined

Dr Westmacott ad nat.   T.West chr.

Archives 1860.

Case II. æt 58. *Ulceration of eight years duration, involving the whole of the skin of the right arm, — healed after trephining the right parietal bone. The ulceration was probably caused by reflex nervous irritation originating in disease of the bones of the skull & producing fits of severe muscular spasm, sometimes of several hours duration.*

(See page 90)
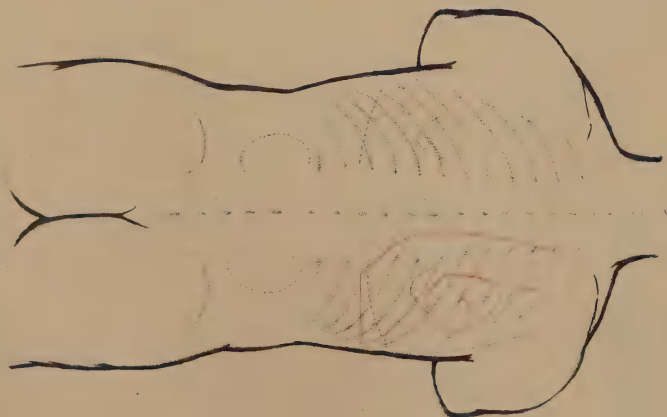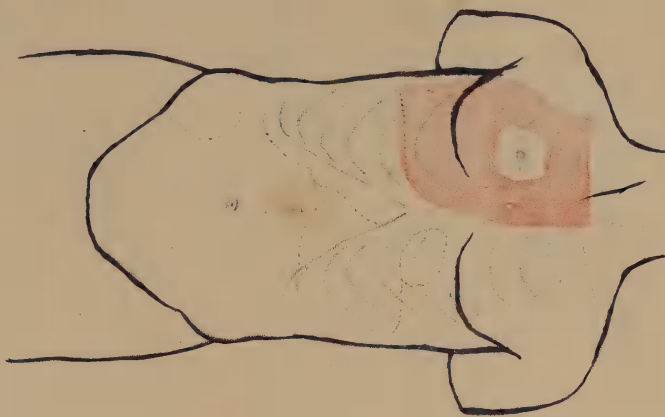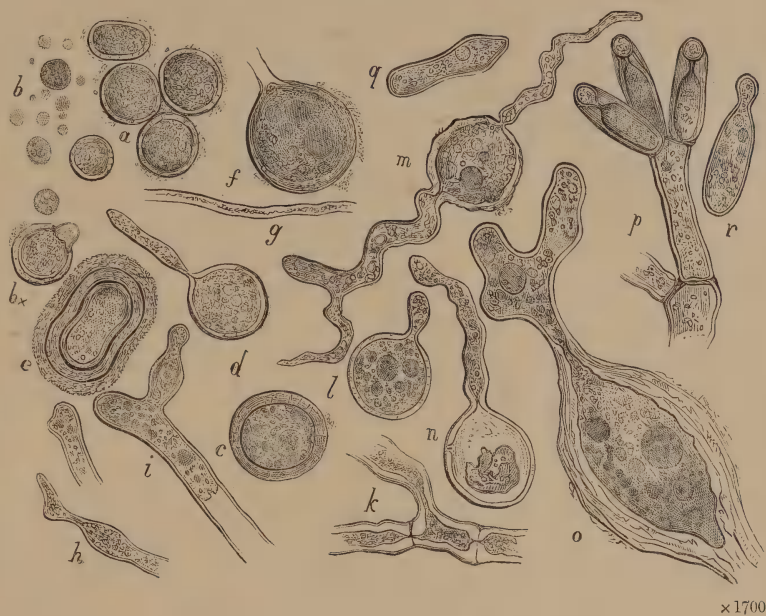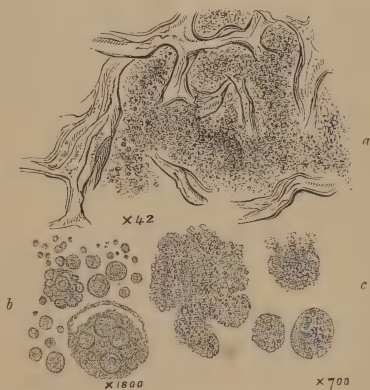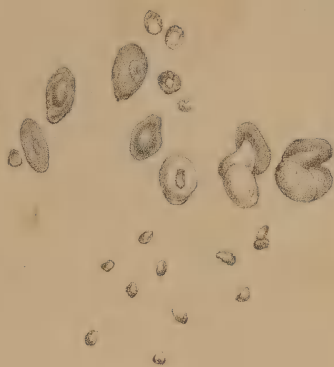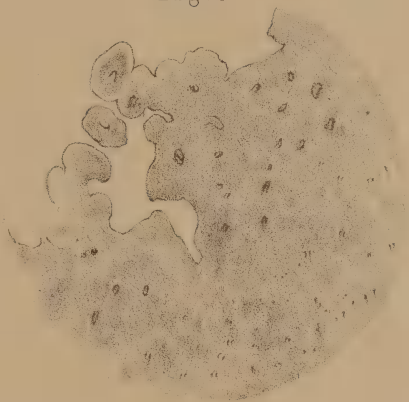
PLATE XI

PLATE XII.

Fig. 1.

×1700

Fig. 2.

Fig. 3.

×350

×42

×1800

×700

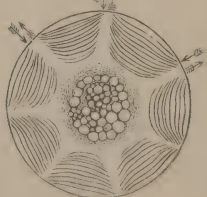| 1000 ths | ⊢_____⌐_____⌐_____⌐_____⌐ ×350 |
| 1000 ths | ⊢_____⌐ ×700 |
| 1000 ths | ⊢_____⌐ ×1700 |

PLATE XIII.

Fig. 1.

Fig. 4.

Fig. 5.

Fig. 3.

Fig. 2.

PLATE XIV.

Fig. 1.

Fig. 2.   Fig. 3.   Fig. 4.

×700   ×700

Fig. 6.   Fig. 5.

×700

a Fig. 8.

Fig. 7.

×700   ×700

1000 ths � ×130
1000 ths ×700

PLATE XV.

Fig. 1.

Fig. 2.

Fig. 3.

×45

×700

Fig. 4

×700
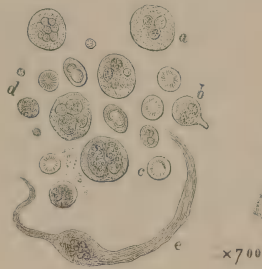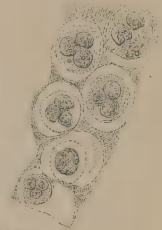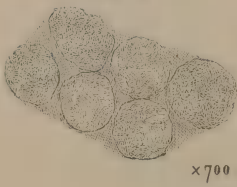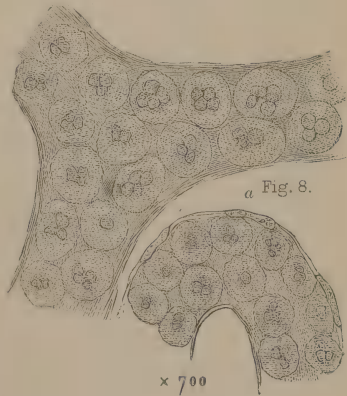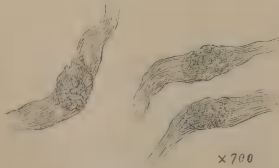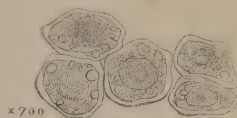
Fig. 5.

Fig. 6.

Fig. 7.

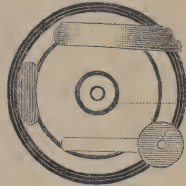Fig. 8.

Fig. 9.

Fig. 10.

PLATE XVI.

Fig. 2.

Fig. 5.

Fig. 1.

a

b

Fig. 6.

*

c

Fig. 3.

Fig. 7.

Fig. 4.

Fig. 8.

Fig. 9.

m

h *i*

k

l